

**CEMENT AND CONCRETE REFERENCE LABORATORY**  
**PROFICIENCY SAMPLE PROGRAM**

**Final Report**  
**Portland Cement Proficiency Samples**  
**Number 185 and Number 186**

August 2012



August 31, 2012

**To: Participants in the CCRL Portland Cement Proficiency Sample Program**

**Subject: Final Report on Portland Cement Proficiency Samples No. 185 and No. 186**

Following is the final report for the current pair of CCRL **Portland Cement** Proficiency Samples which were distributed in June 2012. Portland Cement Samples No. 185 was an ASTM C150 meeting the specifications of Type I and Type II with limestone addition. Portland Cement No. 186 was an ASTM C150 meeting the specifications of Type I and Type II with limestone addition.

This report consists of a statistical Summary of Results, a set of general Scatter Diagrams, and associated detailed information. The Table of Results with individualized information for participating laboratories can be downloaded at our website located at: <http://www.ccrl.us/>. Additional information is provided in the following pages.

The CCRL Proficiency Sample Programs are intended for internal use by the laboratory as a tool to identify potential problems in laboratory procedures or test equipment and to initiate remedial actions. These programs are designed to complement the CCRL Laboratory Inspection Program as part of a total quality system. Care should be taken when using this program for any other purpose.

**Additional samples of these two cements and other CCRL samples are available for purchase.** These samples may be useful for equipment verification, technician training, and research. Contact CCRL for availability and price.

It is presently anticipated that the next Portland Cement Proficiency Samples will be distributed in January 2013.

Sincerely,

Robin K. Haupt  
Supervisor, Proficiency Sample Programs  
Cement and Concrete Reference Laboratory

**TO: Participants in the CCRL Portland Cement Proficiency Sample Program**

**FROM: Robin K. Haupt, Supervisor PSP**

**SUBJECT: Explanation of Final Report on Results of Tests for Portland Cement Proficiency Samples No. 185 and No. 186**

This letter, and the material included with it, constitute the final report, and summary of results for the current pair of Portland Cement Proficiency Samples, which were distributed in June 2012. This material includes a Table of Results for individual laboratory data, a statistical Summary of Results, and a set of general Scatter Diagrams. Your unique laboratory number is displayed at the top of the individual Table of Results.

An explanation of the program is contained in the paper: "Statistical Evaluation of Interlaboratory Cement Tests" by J. R. Crandall and R. L. Blaine [View document](#), and "Statistical Aspects of the Cement Testing Program" by W.J. Youden [View document](#), which can be found in Volume 59, Proceedings of the 62<sup>nd</sup> Annual Meeting of the Society, June 25, 1959, American Society for Testing and Materials.

Each laboratory receives an individualized Table of Results. The Table of Results shows the test title, and the reporting unit in the first two columns. After that it lists in order, the laboratory's results for the odd and even numbered samples, overall averages for the odd and even numbered samples, and the laboratory's ratings for the odd and even samples.

Laboratory ratings, shown in the Table of Results for the individual laboratory, were determined in the manner described by Crandall and Blaine using a rating scale of 1 to 5 instead of 0 to 4. The ratings have no valid standing beyond showing the difference between the individual laboratory result and the average for a particular test.

The following table details the relationship between the ratings and the averages.

<b>Ratings</b>	<b>Range (Number of Standard Deviations)</b>	<b>Number (Per 100) of Laboratories achieving the rating <sup>1</sup></b>
5	Less than 1	69
4	1 to 1.5	18
3	1.5 to 2	9
2	2 to 2.5	3
1	Greater than 2.5	1

The sign of the rating merely shows whether the result reported was greater or less than the average obtained.

Participants subscribing to the primary chemical analysis portion of this report should note that the statistics were calculated using data obtained by wet methods, and rapid methods of chemical analysis. Participants in the secondary chemical analysis should note that laboratory ratings are assigned using primary chemical statistics.

Please note that individual laboratory ratings were not given for the flow of air content mortar (test no. 190) and compressive strength mortar (test no. 230). Air content flows in the range of  $87.5 \pm 7.5$  are satisfactory,

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<sup>1</sup>Youden, W.J., "Statistical Aspects of the Cement Testing Program", Volume 59, *Proceedings of the 62<sup>nd</sup> Annual Meeting of the Society, June 25, 1959, American Society for Testing and Materials.*

labs with flow values outside this range will be flagged as a “Labs Eliminated” or “Labs Off Diagram” on the scatter diagram. Averages, standard deviations, and a scatter diagram are provided for your information. This information may be a helpful indicator of a problem with flow table apparatus or mortar mixing procedures. Flow values of 151 were assigned to laboratories reporting a mortar flow off the flow table top.

In cases where some laboratories' results are eliminated, averages, standard deviations, coefficients of variation, and the ratings of the other laboratories' results, are recalculated using the data remaining after the elimination. Since the laboratory ratings given are the results from this one series of tests, you need not attach too much significance to a single low rating, or pair of ratings, from this one series. A continuing tendency to get low ratings on several pairs of samples should lead a laboratory to consider the types of error, systematic and random, contribute to ratings that are low. Systematic error, which is indicated by low ratings with the same signs on each pair of samples, means a consistent error is occurring in equipment and/or test procedures. One indication of random error is low ratings on both samples with different signs. Since systematic error occurs with more regularity, its cause is generally easier to find than the cause of random error.

### **Summary of Results**

Usually, averages, standard deviations, and coefficients of variation are given with all results reported, and then with one or more outlying results omitted. Sometimes, two or more recalculations with laboratories omitted, have been done for the same test. In these cases, all of the laboratories omitted in previous recalculations are also omitted in subsequent ones. Results omitted are values that are more than three standard deviations from the mean of one or both samples. Often, elimination of these outlying results has little effect on the average, but may have a more pronounced effect on the standard deviation and coefficient of variation.

### **Scatter Diagrams**

General scatter diagrams are supplied with this report. Crandall and Blaine describe the manner of preparing scatter diagrams, and their interpretation, in the paper published in the 1959 ASTM Proceedings. Each laboratory will receive a complete set of diagrams according to their subscription to the given program.

Using the results received from each laboratory, a scatter diagram is generated for each test method by plotting the value for the odd numbered samples on the *X*, or horizontal axis, against the value for the even numbered samples on the *Y*, or vertical axis. To find your point, just plot as you would when plotting any scatter diagram. Vertical and horizontal dashed lines, which divide the diagrams into four sections or quadrants, place the average values for the odd and even numbered samples, respectively. The first line of print under the diagram includes the test number, as given on the data sheet, the test title, and the number of data points on the diagrams. The number of plotted points may not agree with the total number of data pairs included in the analysis because a few points may be off the diagram, and some points may represent several data pairs, which are identical. Laboratories whose points are off the diagram will have a rating of  $\pm 1$  for that particular test. As described in Crandall and Blaine, a tight circular pattern of points around the intersection of the median lines is the ideal situation. Stretching out of the pattern into the first (upper right) and third (lower left) quadrants, suggests some kind of bias, or tendency for laboratories to get high or low results on both samples. Examination of the scatter diagrams indicates strong evidence of bias on many tests.

**CCRL PROFICIENCY SAMPLE PROGRAM**  
 Portland Cement Proficiency Samples No. 185 and No. 186

Final Report – Primary Chemical Results  
 August 31, 2012

SUMMARY OF RESULTS

Sample No.185

Sample No. 186

Test (unit)	#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.
<b>Silicon Dioxide (percent)</b>							
	237	19.66	0.44	2.22	20.63	0.43	2.08
	*228	19.61	0.22	1.10	20.61	0.20	0.99
* Labs Eliminated - 4, 50, 51, 53, 93, 181, 284, 1526, 3233							
<b>Aluminum Oxide (percent)</b>							
	232	5.09	0.16	3.1	5.19	0.11	2.2
	*226	5.09	0.11	2.1	5.18	0.10	1.8
* Labs Eliminated - 40, 53, 74, 1525, 1715, 3735							
<b>Ferric Oxide (percent)</b>							
	233	3.60	0.15	4.2	3.65	0.09	2.6
	*221	3.59	0.05	1.5	3.65	0.05	1.4
* Labs Eliminated - 51, 157, 687, 690, 736, 1525, 1715, 2039, 2251, 3059, 3235, 3279							
<b>Calcium Oxide (percent)</b>							
	233	63.81	0.54	0.84	64.07	2.11	3.30
	*224	63.81	0.39	0.62	63.95	0.40	0.63
* Labs Eliminated - 4, 50, 53, 222, 284, 840, 1054, 1526, 3297							
<b>Magnesium Oxide (percent)</b>							
	234	0.98	0.10	10.1	0.89	0.12	13.4
	*217	0.98	0.05	5.1	0.89	0.05	5.6
* Labs Eliminated - 1, 4, 28, 48, 53, 95, 176, 206, 1525, 1526, 2463, 2490, 2491, 3059, 3233, 3279, 3661							
<b>Sulfur Trioxide (percent)</b>							
	233	3.05	0.24	7.7	2.77	0.20	7.2
	*223	3.08	0.08	2.5	2.79	0.07	2.6
* Labs Eliminated - 35, 51, 53, 181, 203, 690, 840, 1525, 3233, 3297							
<b>Loss on Ignition (percent)</b>							
	237	2.65	0.24	9.2	2.16	0.26	11.9
	*222	2.65	0.10	3.8	2.15	0.11	5.3
* Labs Eliminated - 51, 90, 132, 181, 203, 407, 768, 840, 886, 1054, 1940, 2463, 3059, 3233, 3297							

**CCRL PROFICIENCY SAMPLE PROGRAM**  
 Portland Cement Proficiency Samples No. 185 and No. 186

Final Report – Primary Chemical Results  
 August 31, 2012

SUMMARY OF RESULTS

Sample No.185

Sample No. 186

Test (unit)	#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.
<b>Sodium Oxide (percent)</b>							
	217	0.126	0.044	35	0.107	0.037	35
	*212	0.121	0.031	26	0.104	0.029	27
* Labs Eliminated - 696, 779, 840, 2360, 3663							
<b>Potassium Oxide (percent)</b>							
	224	0.373	0.030	8.1	0.451	0.046	10.2
	*211	0.369	0.014	3.7	0.452	0.014	3.0
* Labs Eliminated - 52, 60, 129, 181, 440, 840, 1715, 1956, 2465, 3233, 3235, 3607, 3663							
<b>Titanium Dioxide (percent)</b>							
	183	0.25	0.013	5.0	0.27	0.013	4.9
	*180	0.25	0.009	3.7	0.27	0.010	3.7
* Labs Eliminated - 162, 2462, 2484							
<b>Phosphorus Pentoxide (percent)</b>							
	179	0.475	0.064	13.5	0.119	0.052	44.1
	*157	0.484	0.017	3.5	0.113	0.006	4.9
* Labs Eliminated - 8, 27, 34, 53, 69, 84, 93, 139, 181, 493, 501, 684, 687, 1466, 1483, 1799, 2292, 2462, 2484, 2491, 3233, 3662							
<b>Zinc Oxide (percent)</b>							
	93	0.132	0.017	13.1	0.012	0.005	39.5
	*86	0.134	0.005	4.1	0.012	0.002	18.2
* Labs Eliminated - 40, 206, 501, 932, 1466, 2491, 3605							
<b>Manganic Oxide (percent)</b>							
	143	0.114	0.019	16.7	0.022	0.032	146.4
	*127	0.113	0.004	3.4	0.015	0.003	22.4
* Labs Eliminated - 95, 162, 178, 181, 203, 205, 413, 416, 457, 501, 691, 2305, 2462, 2491, 3057, 3752							
<b>Chloride (percent)</b>							
	112	0.014	0.032	229	0.008	0.012	165
	*100	0.007	0.003	49	0.005	0.003	60
* Labs Eliminated - 129, 158, 684, 692, 696, 768, 886, 1466, 2308, 2491, 3057, 3661							

**CCRL PROFICIENCY SAMPLE PROGRAM**  
Portland Cement Proficiency Samples No. 185 and No. 186

Final Report – Primary Chemical Results  
August 31, 2012

SUMMARY OF RESULTS

Sample No.185

Sample No. 186

Test (unit)	#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.
<b>Insoluble Residue (percent)</b>							
	215	0.22	0.22	102	0.41	0.20	48
	*205	0.19	0.10	50	0.38	0.11	28
* Labs Eliminated - 51, 134, 206, 222, 413, 497, 687, 840, 2305, 2477							
<b>Free Lime (percent)</b>							
	178	1.25	0.27	22	0.89	0.21	24
	*172	1.25	0.23	19	0.88	0.17	20
* Labs Eliminated - 69, 206, 244, 690, 886, 3443							
<b>Carbon Dioxide (percent)</b>							
	197	1.41	0.32	23.0	0.99	0.29	29.5
	*182	1.41	0.19	13.4	0.96	0.16	16.6
* Labs Eliminated - 56, 94, 95, 129, 132, 137, 181, 221, 415, 886, 1715, 2491, 3233, 3279, 3752							
<b>Limestone Content (percent)</b>							
	196	3.4	0.8	24.6	2.3	0.7	28.0
	*180	3.4	0.5	13.9	2.3	0.4	16.8
* Labs Eliminated - 56, 95, 129, 132, 137, 181, 221, 415, 886, 1079, 1715, 2477, 2484, 2491, 3279, 3752							
<b>Chromium Oxide (percent)</b>							
	89	0.021	0.005	24	0.012	0.009	73
	*84	0.021	0.004	18	0.011	0.004	34
* Labs Eliminated - 15, 157, 438, 2491, 3752							
<b>Tricalcium Silicate (percent)</b>							
	200	56.8	3.7	6.5	54.2	3.5	6.5
	*195	56.7	3.5	6.1	54.1	2.7	4.9
* Labs Eliminated - 50, 1525, 2477, 2621, 3415							
<b>Dicalcium Silicate (percent)</b>							
	199	13.3	3.2	23.9	17.6	3.0	16.9
	*194	13.3	2.9	22.0	17.7	2.3	13.2
* Labs Eliminated - 50, 1525, 1526, 2621, 3415							

**CCRL PROFICIENCY SAMPLE PROGRAM**  
 Portland Cement Proficiency Samples No. 185 and No. 186

Final Report – Primary Chemical Results  
 August 31, 2012

SUMMARY OF RESULTS

Sample No.185

Sample No. 186

Test (unit)	#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.
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**Tricalcium Aluminate (percent)**

199	7.4	0.4	5.7	7.4	0.4	5.0
*196	7.4	0.3	4.3	7.4	0.3	4.1

\* Labs Eliminated - 40, 1525, 1715

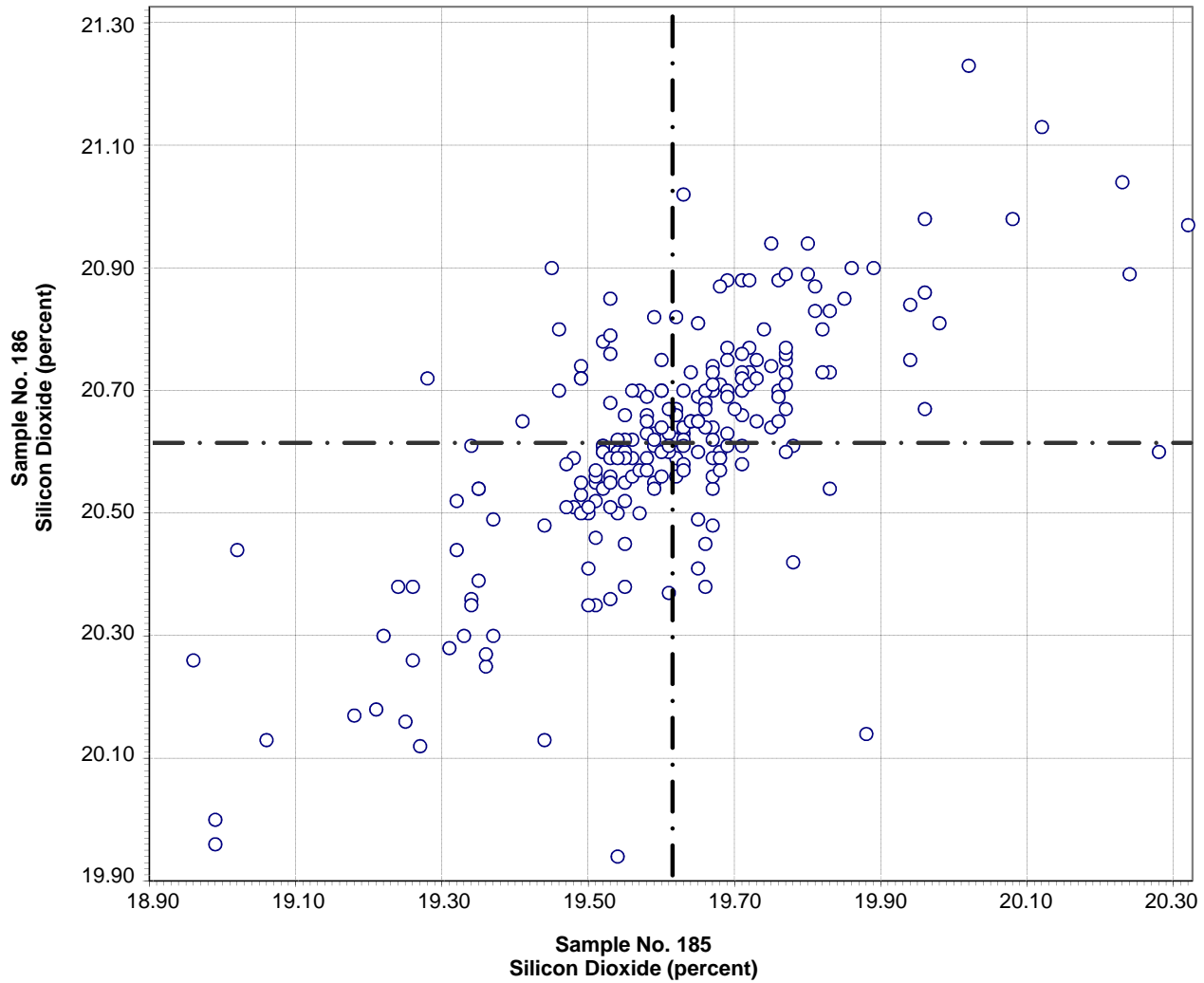
**Tetracalcium Aluminoferrite (percent)**

199	10.9	0.2	2.1	11.1	0.3	2.7
*193	10.9	0.2	1.8	11.0	0.2	1.7

\* Labs Eliminated - 157, 457, 687, 1715, 2251, 3279



**CCRL Proficiency Sample Program  
Silicon Dioxide  
PORTLAND CEMENT Samples No. 185 and No. 186**



**Test No. 10    Silicon Dioxide    225 Points**

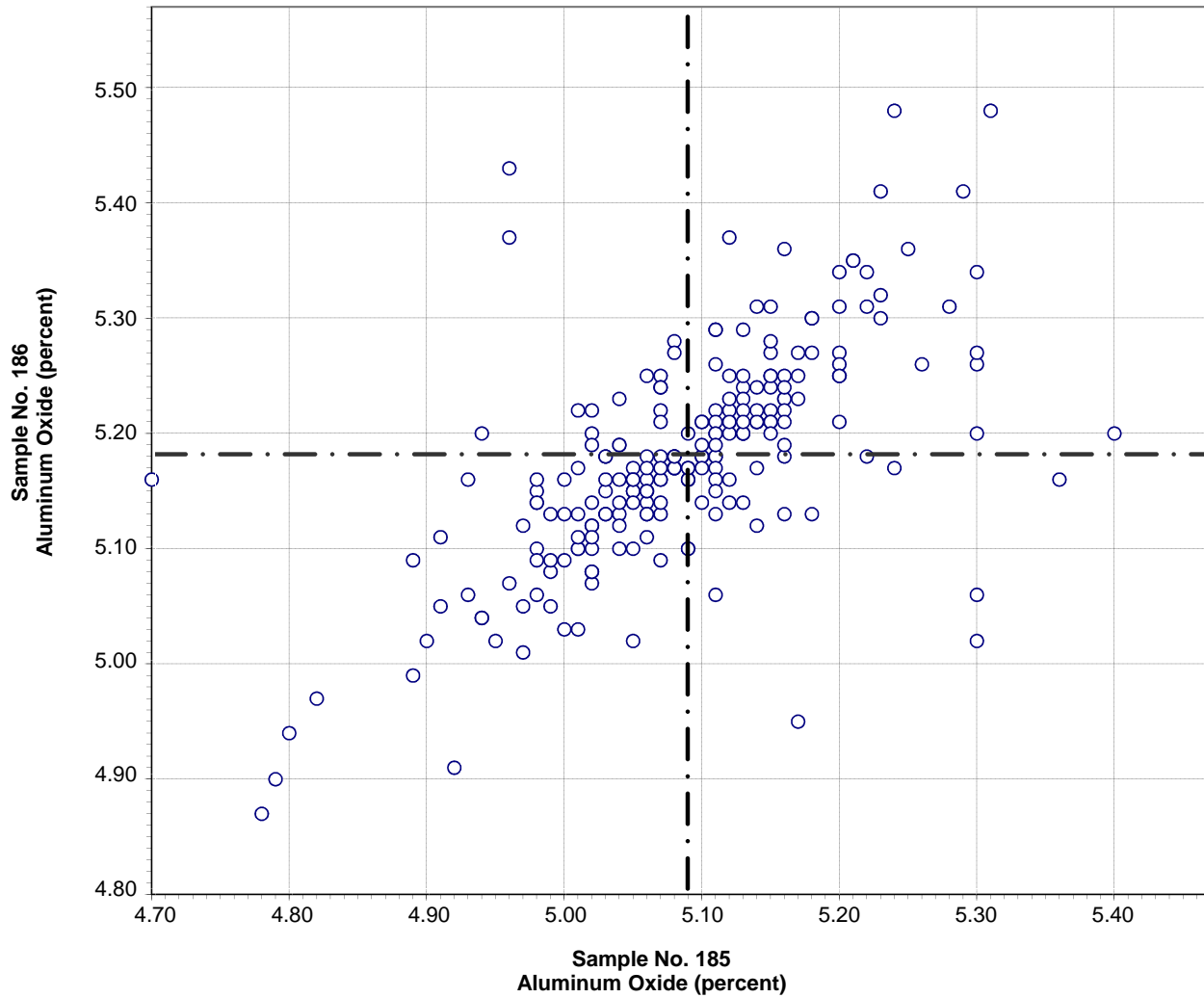
Sample No. 185    Ave 19.61    S.D. 0.22    C.V. 1.10

Sample No. 186    Ave 20.61    S.D. 0.20    C.V. 0.99

Labs Eliminated: 4, 50, 51, 53, 93, 181, 284, 1526, 3233

Labs off Diagram: 48, 94, 2464

**CCRL Proficiency Sample Program  
Aluminum Oxide  
PORTLAND CEMENT Samples No. 185 and No. 186**



Test No. 21    Aluminum Oxide    225 Points

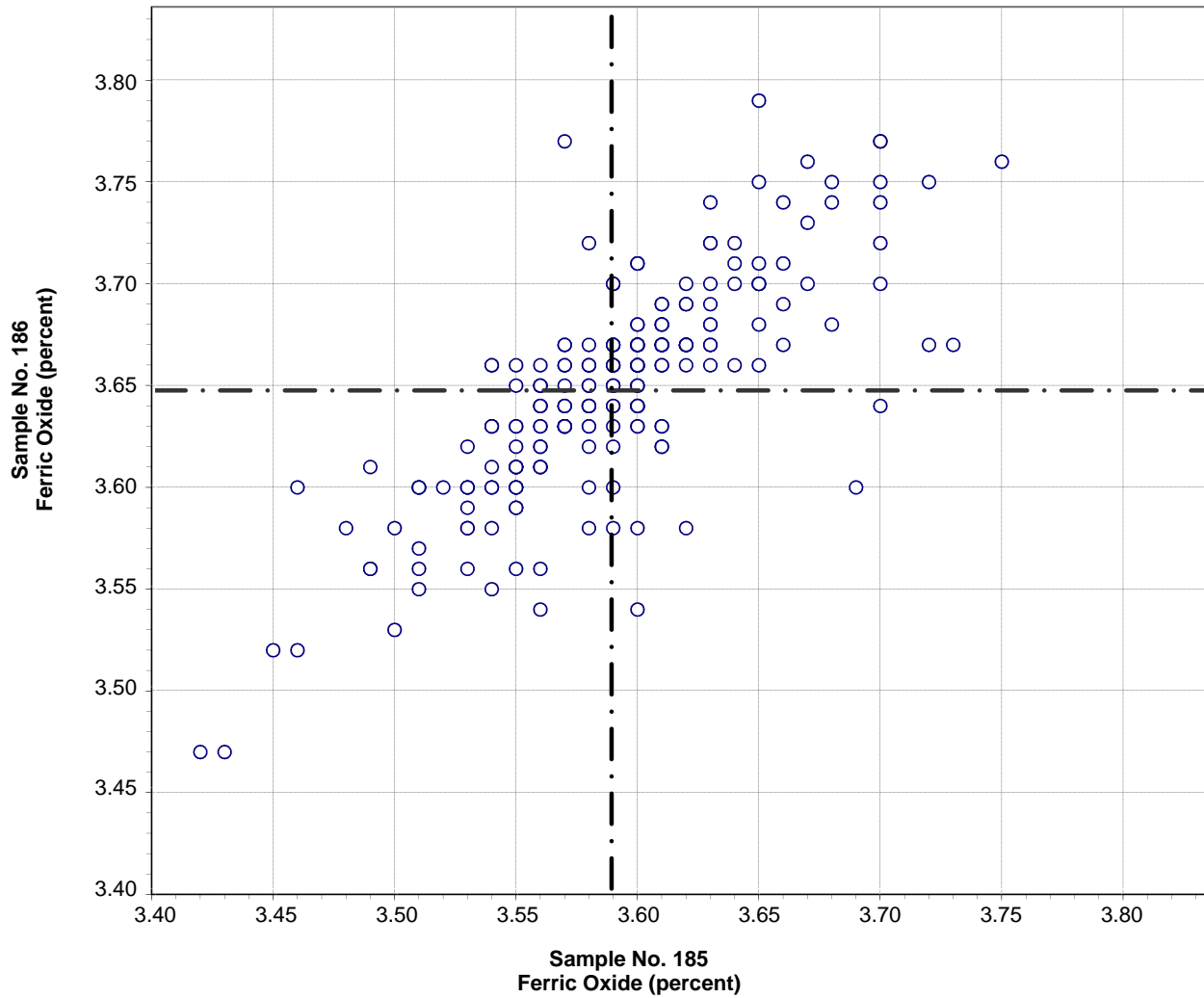
Sample No. 185    Ave 5.09    S.D. 0.11    C.V. 2.1

Sample No. 186    Ave 5.18    S.D. 0.10    C.V. 1.8

Labs Eliminated: 40, 53, 74, 1525, 1715, 3735

Labs off Diagram: 3606

**CCRL Proficiency Sample Program  
Ferric Oxide  
PORTLAND CEMENT Samples No. 185 and No. 186**

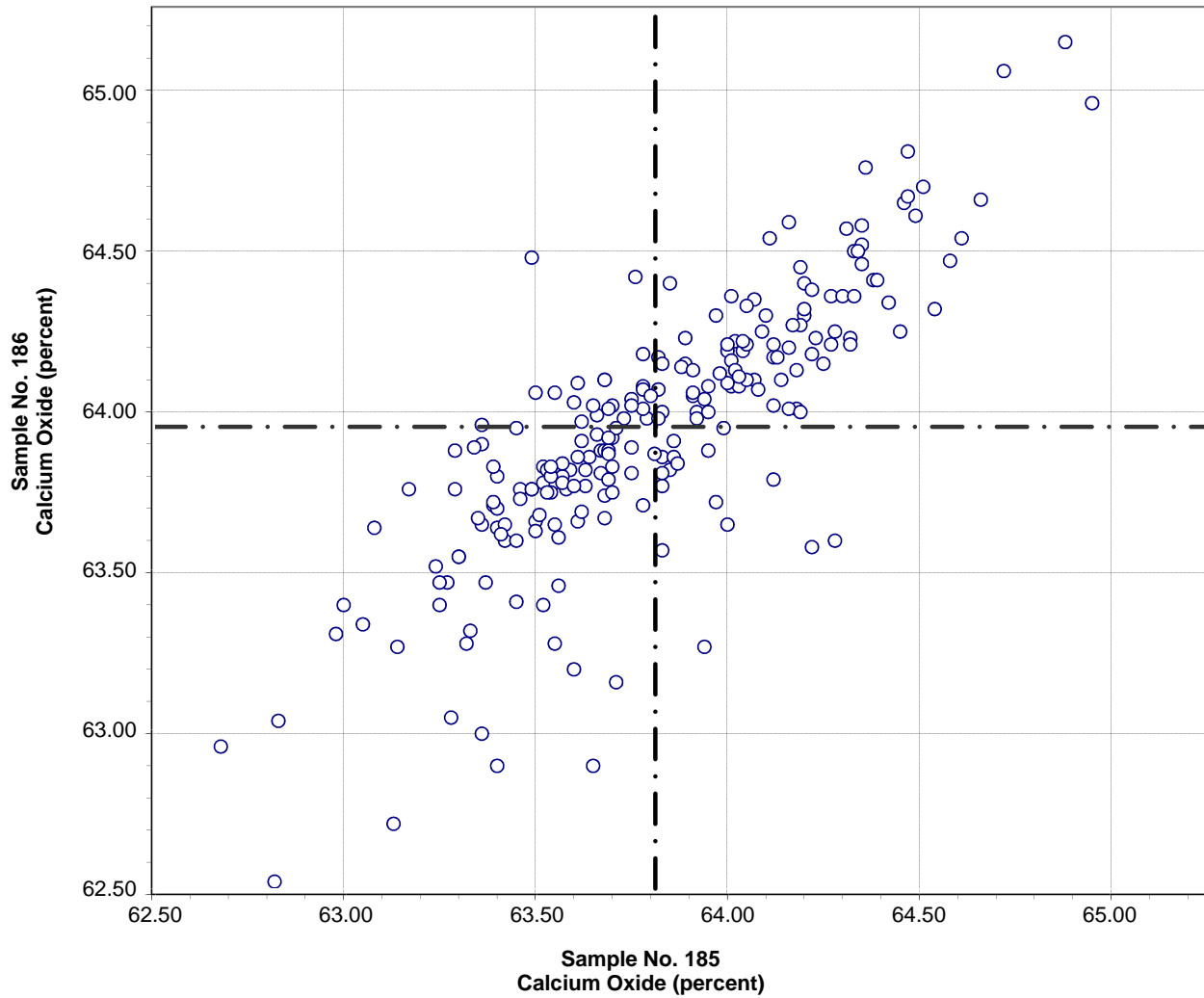


Test No. 30    Ferric Oxide    221 Points

Sample No. 185    Ave 3.59    S.D. 0.05    C.V. 1.5  
Sample No. 186    Ave 3.65    S.D. 0.05    C.V. 1.4

Labs Eliminated: 51, 157, 687, 690, 736, 1525, 1715, 2039, 2251, 3059, 3235, 3279

**CCRL Proficiency Sample Program  
Calcium Oxide  
PORTLAND CEMENT Samples No. 185 and No. 186**



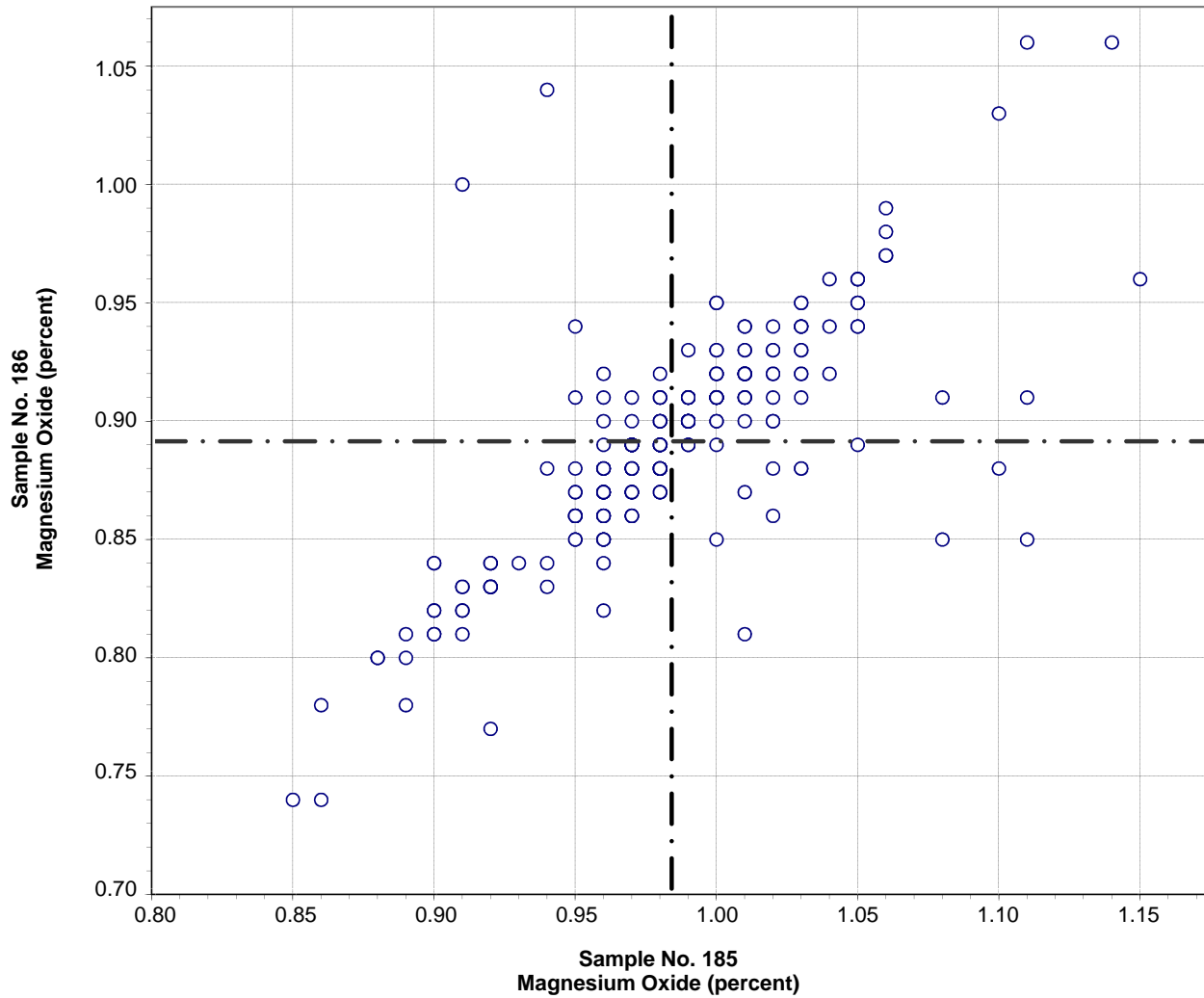
**Test No. 40    Calcium Oxide    224 Points**

Sample No. 185    Ave 63.81    S.D. 0.39    C.V. 0.62

Sample No. 186    Ave 63.95    S.D. 0.40    C.V. 0.63

Labs Eliminated: 4, 50, 53, 222, 284, 840, 1054, 1526, 3297

**CCRL Proficiency Sample Program  
Magnesium Oxide  
PORTLAND CEMENT Samples No. 185 and No. 186**



**Test No. 50    Magnesium Oxide    216 Points**

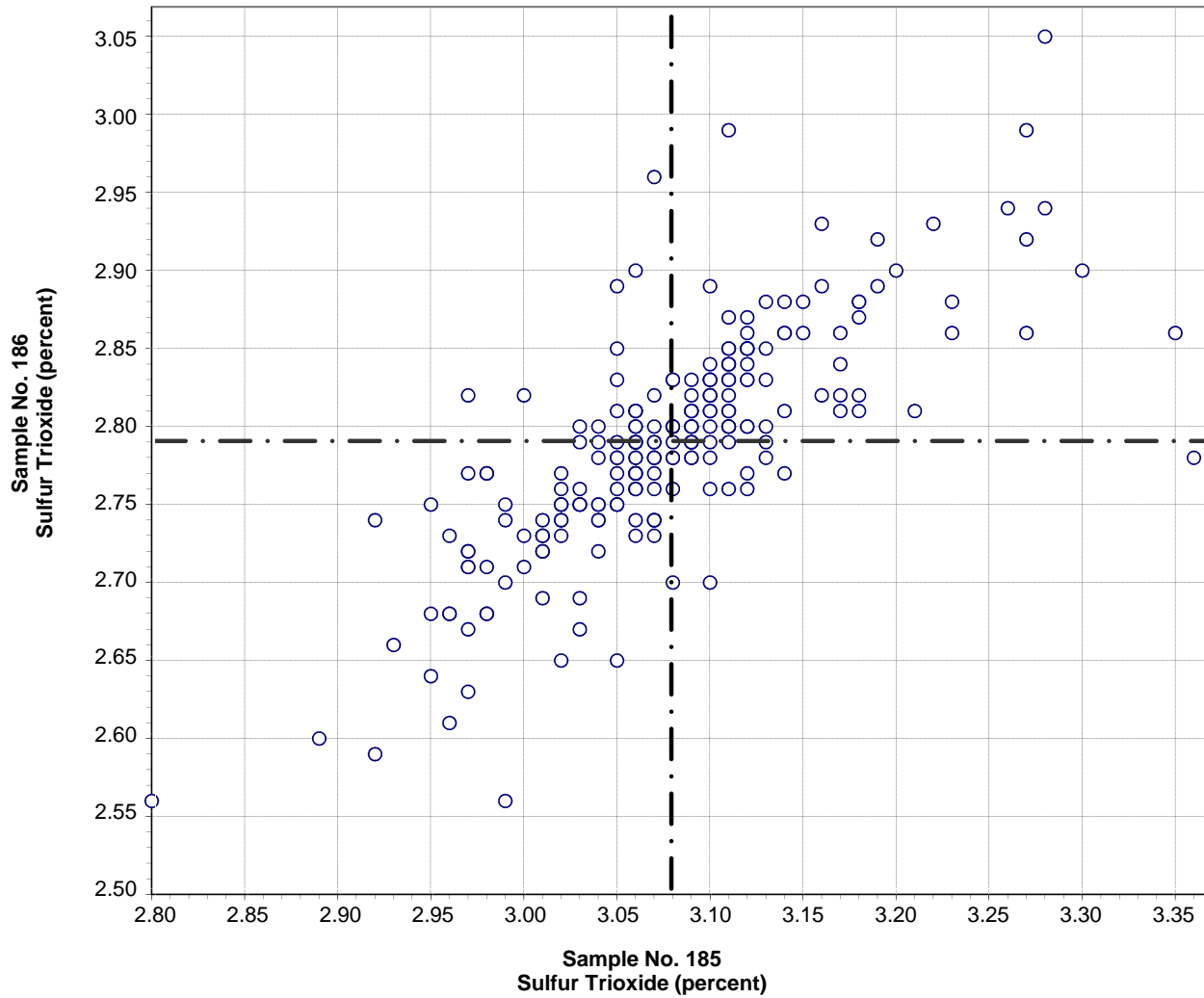
Sample No. 185    Ave 0.98    S.D. 0.05    C.V. 5.1

Sample No. 186    Ave 0.89    S.D. 0.05    C.V. 5.6

Labs Eliminated: 1, 4, 28, 48, 53, 95, 176, 206, 1525, 1526, 2463, 2490, 2491,  
3059, 3233, 3279, 3661

Labs off Diagram: 3663

**CCRL Proficiency Sample Program**  
**Sulfur Trioxide**  
**PORTLAND CEMENT Samples No. 185 and No. 186**



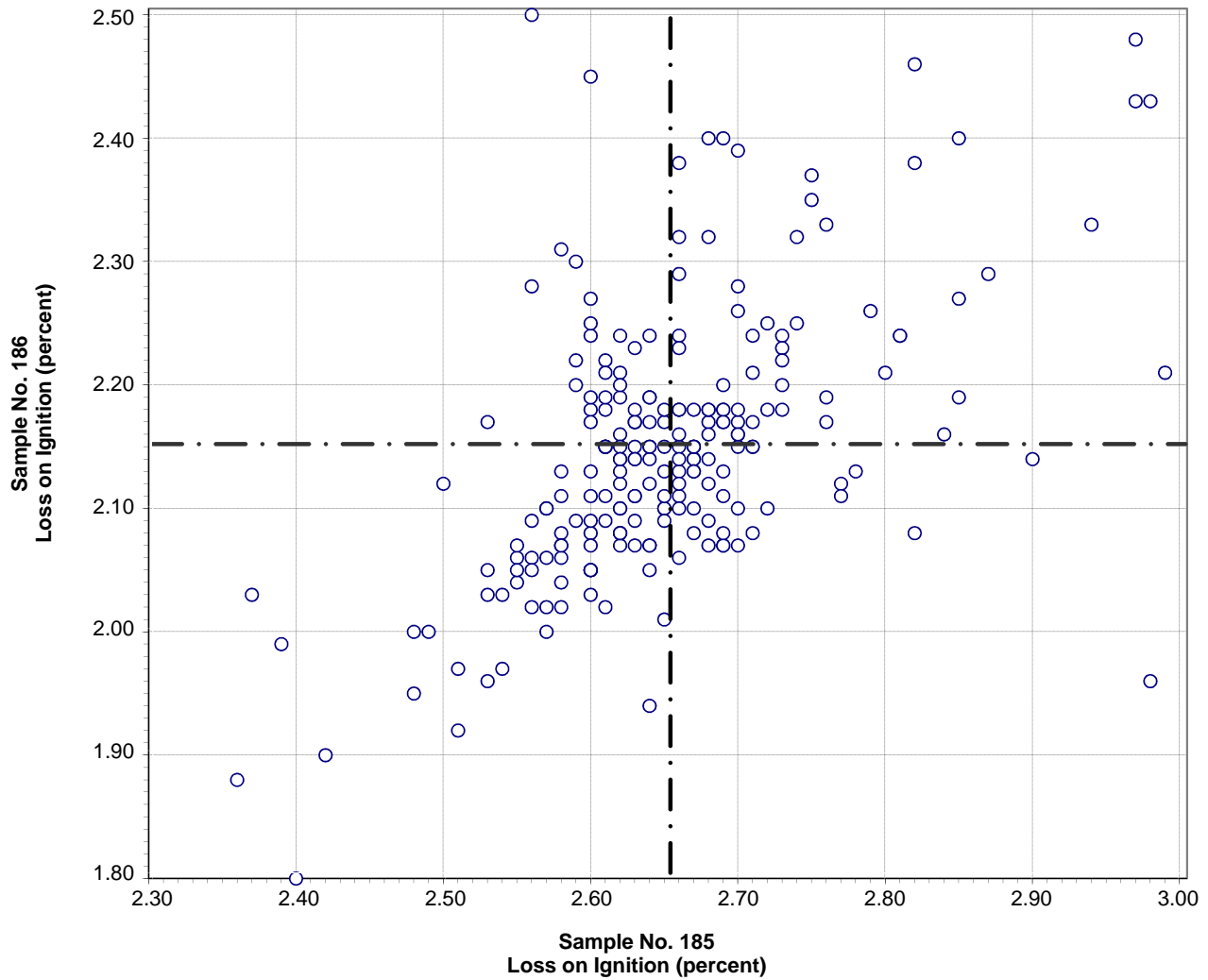
**Test No. 60    Sulfur Trioxide    223 Points**

Sample No. 185    Ave 3.08    S.D. 0.08    C.V. 2.5

Sample No. 186    Ave 2.79    S.D. 0.07    C.V. 2.6

Labs Eliminated: 35, 51, 53, 181, 203, 690, 840, 1525, 3233, 3297

**CCRL Proficiency Sample Program**  
**Loss on Ignition**  
**PORTLAND CEMENT Samples No. 185 and No. 186**



**Test No. 70    Loss on Ignition    220 Points**

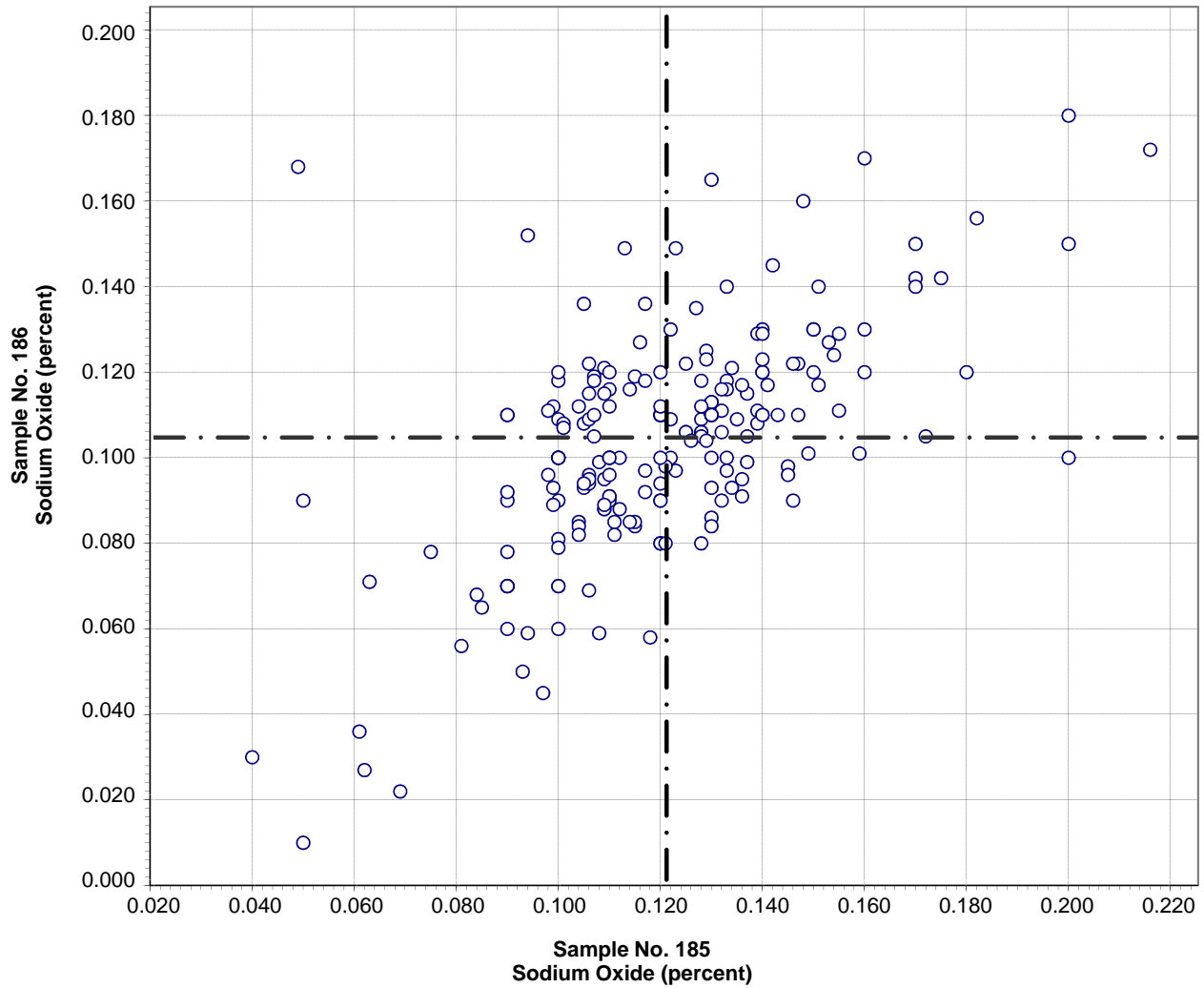
Sample No. 185    Ave 2.65    S.D. 0.10    C.V. 3.8

Sample No. 186    Ave 2.15    S.D. 0.11    C.V. 5.3

Labs Eliminated: 51, 90, 132, 181, 203, 407, 768, 840, 886, 1054, 1940, 2463,  
3059, 3233, 3297

Labs off Diagram: 48, 247

**CCRL Proficiency Sample Program  
Sodium Oxide  
PORTLAND CEMENT Samples No. 185 and No. 186**



Test No. 90    Sodium Oxide    207 Points

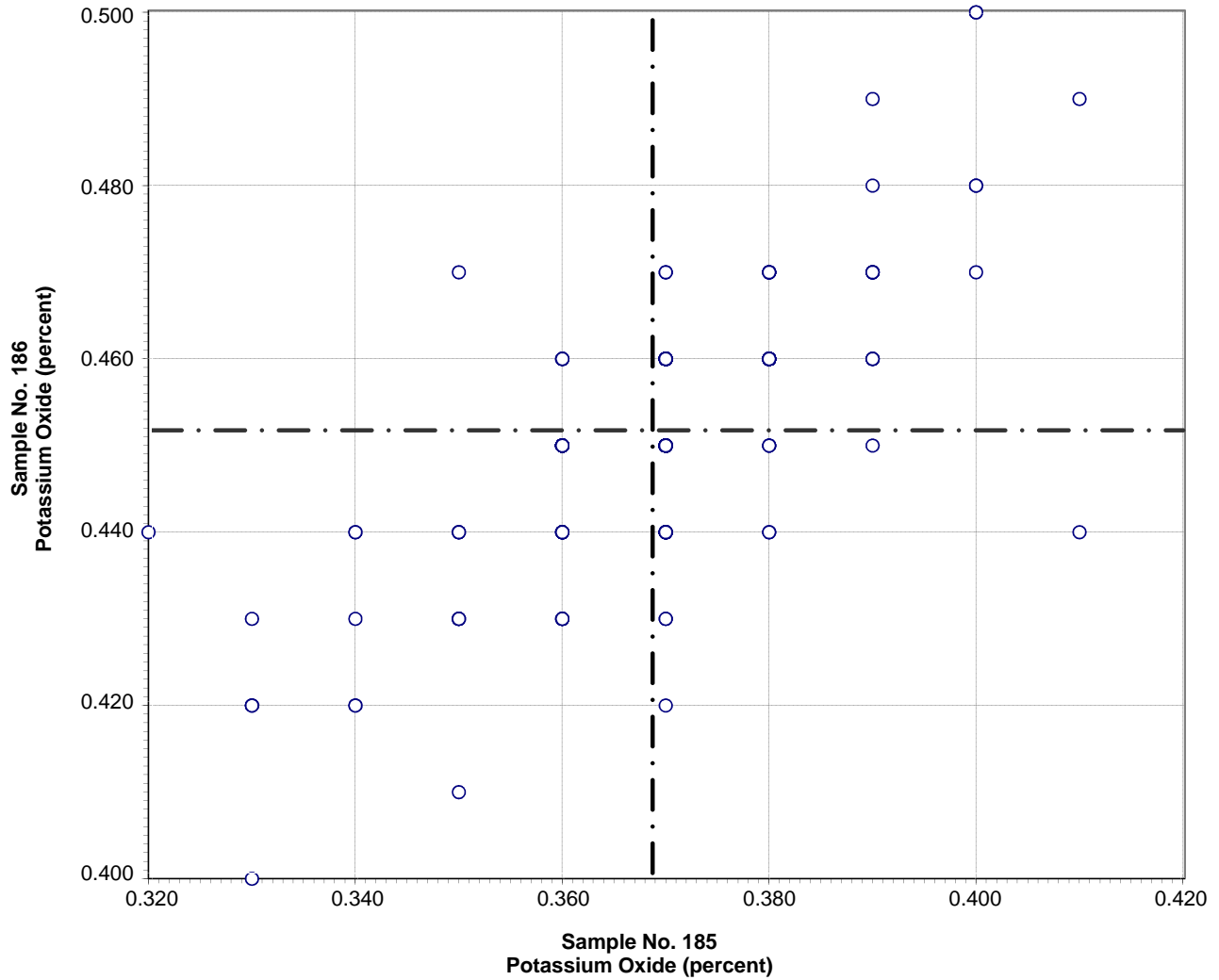
Sample No. 185    Ave 0.121    S.D. 0.031    C.V. 26  
Sample No. 186    Ave 0.104    S.D. 0.029    C.V. 27

Labs Eliminated: 696, 779, 840, 2360, 3663

Labs off Diagram: 695, 2462, 2463, 3233, 3658



**CCRL Proficiency Sample Program  
Potassium Oxide  
PORTLAND CEMENT Samples No. 185 and No. 186**

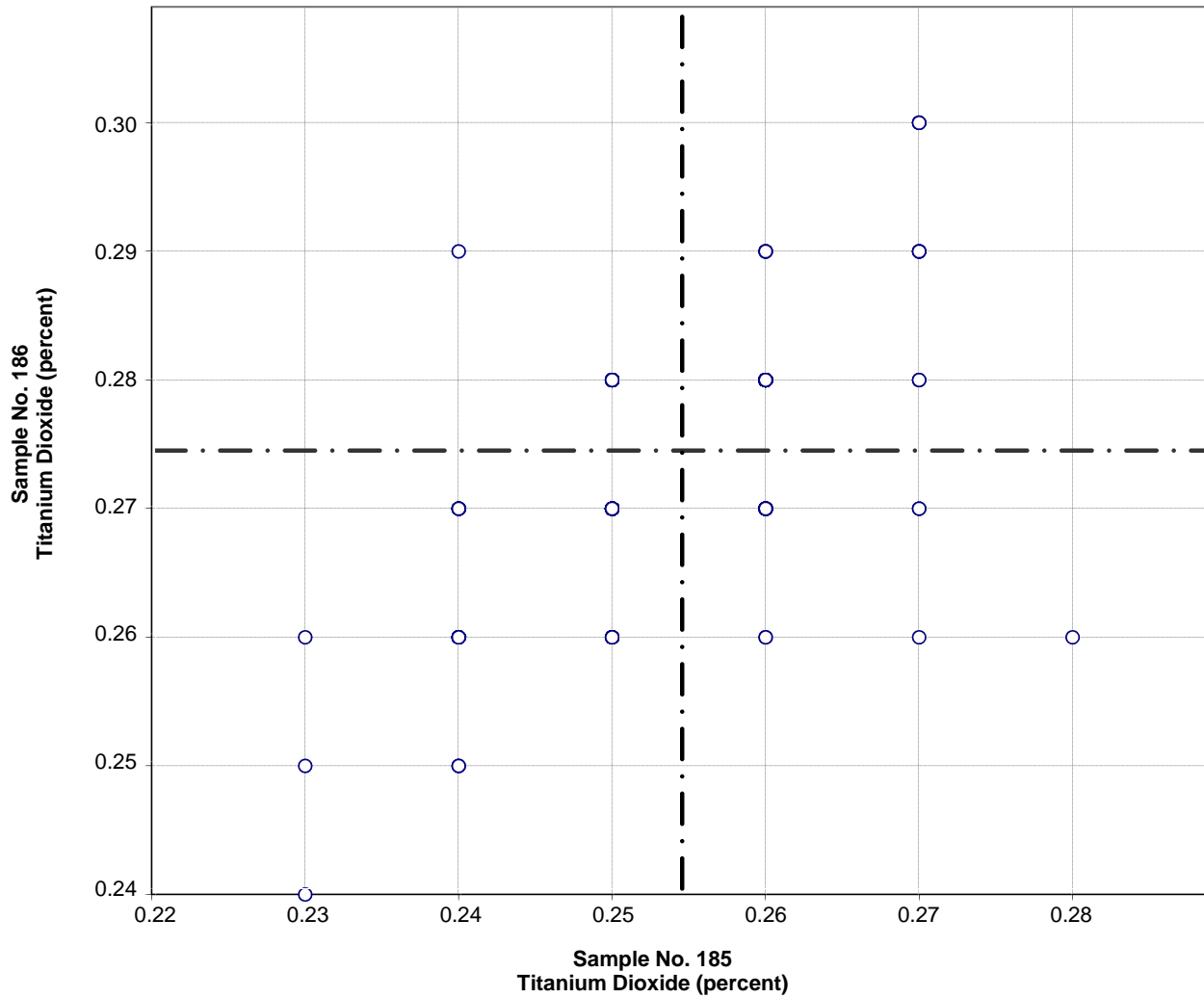


**Test No. 100 Potassium Oxide 211 Points**

Sample No. 185 Ave 0.369 S.D. 0.014 C.V. 3.7  
 Sample No. 186 Ave 0.452 S.D. 0.014 C.V. 3.0

Labs Eliminated: 52, 60, 129, 181, 440, 840, 1715, 1956, 2465, 3233, 3235, 3607, 3663

**CCRL Proficiency Sample Program  
Titanium Dioxide  
PORTLAND CEMENT Samples No. 185 and No. 186**



**Test No. 103    Titanium Dioxide    176 Points**

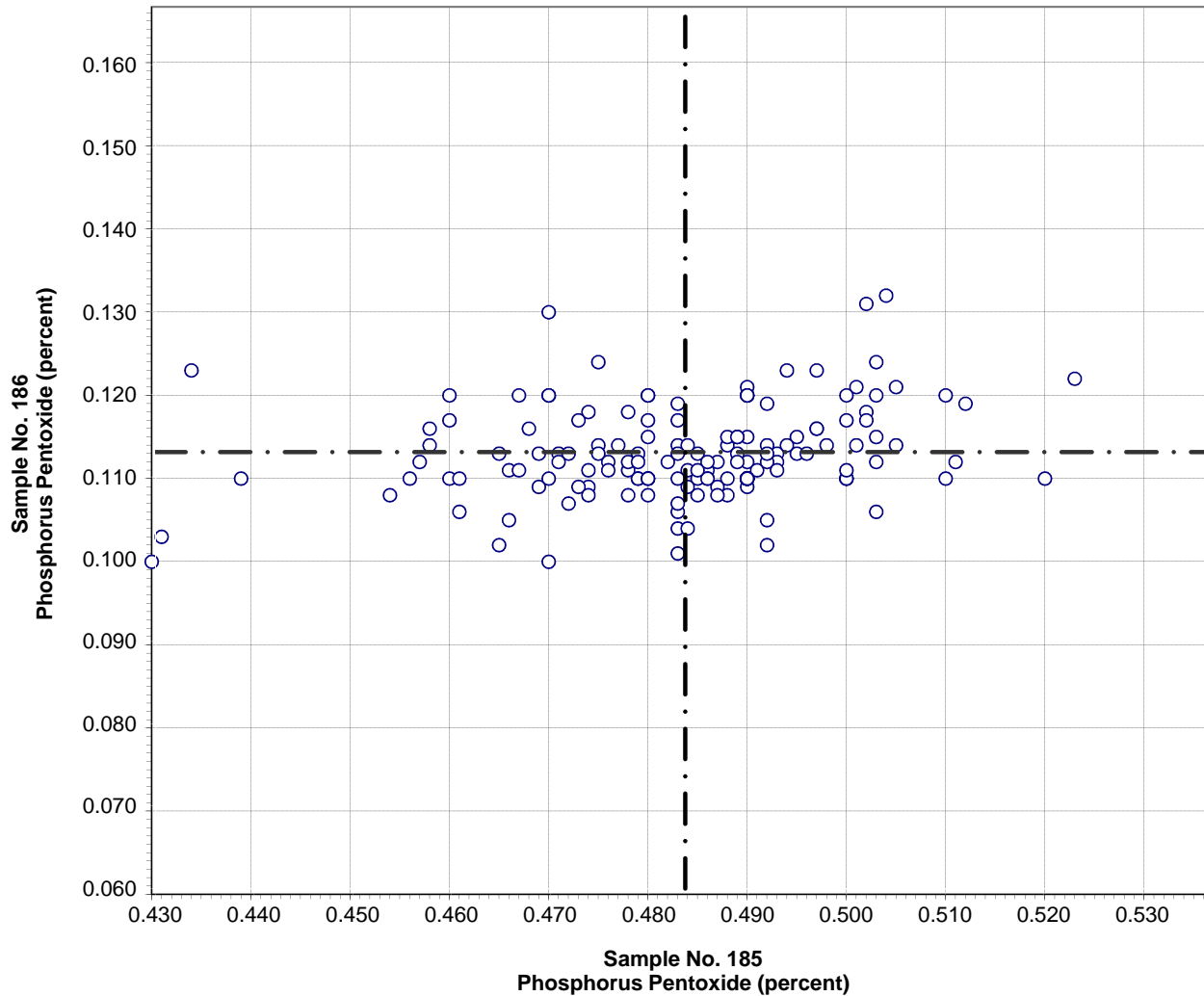
Sample No. 185    Ave 0.25    S.D. 0.009    C.V. 3.7

Sample No. 186    Ave 0.27    S.D. 0.010    C.V. 3.7

Labs Eliminated: 162, 2462, 2484

Labs off Diagram: 53, 696, 2251, 3705

**CCRL Proficiency Sample Program  
Phosphorus Pentoxide  
PORTLAND CEMENT Samples No. 185 and No. 186**



**Test No. 102 Phosphorus Pentoxide 155 Points**

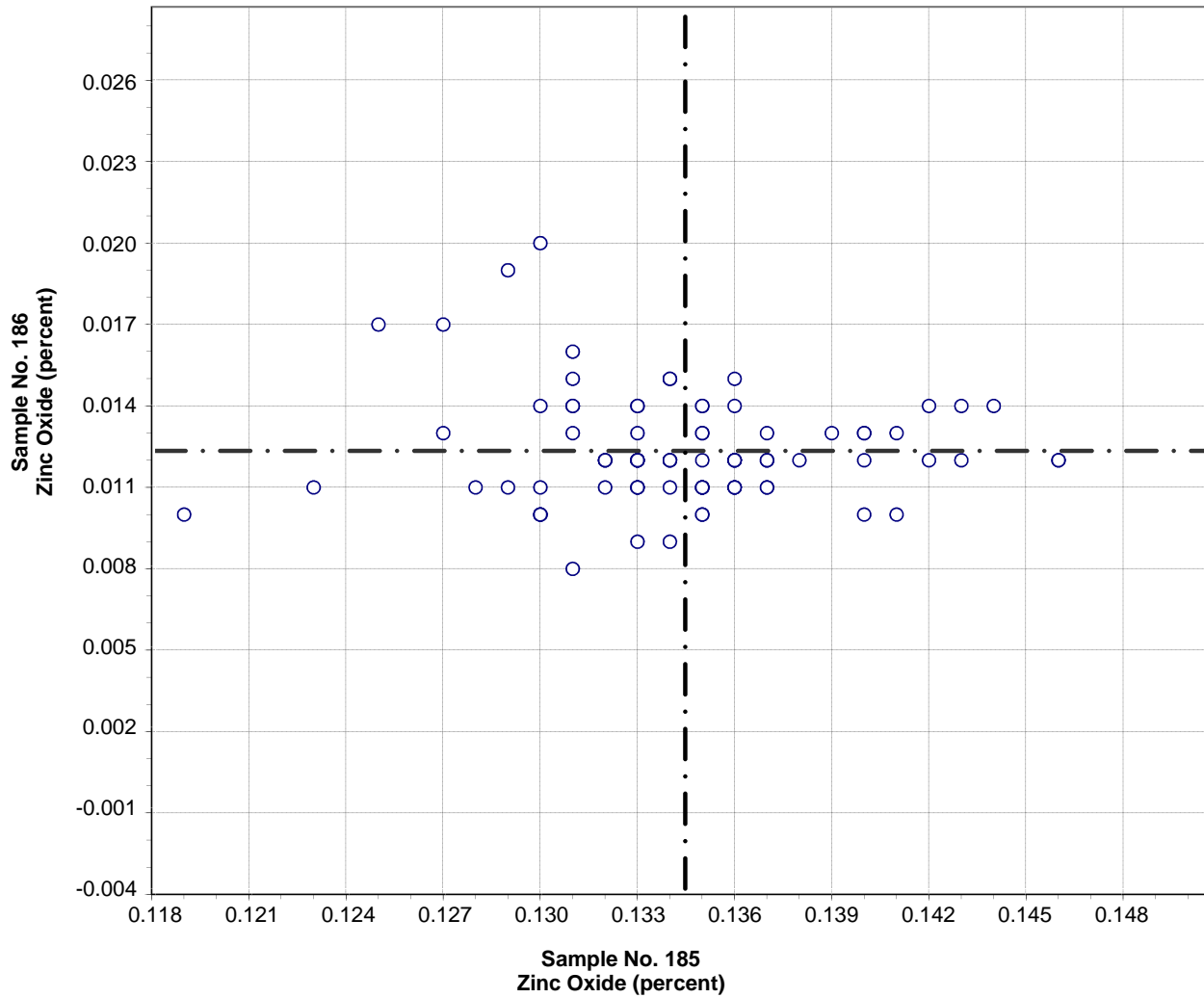
Sample No. 185 Ave 0.484 S.D. 0.017 C.V. 3.5

Sample No. 186 Ave 0.113 S.D. 0.006 C.V. 4.9

Labs Eliminated: 8, 27, 34, 53, 69, 84, 93, 139, 181, 493, 501, 684, 687, 1466,  
1483, 1799, 2292, 2462, 2484, 2491, 3233, 3662

Labs off Diagram: 28, 178

**CCRL Proficiency Sample Program  
Zinc Oxide  
PORTLAND CEMENT Samples No. 185 and No. 186**



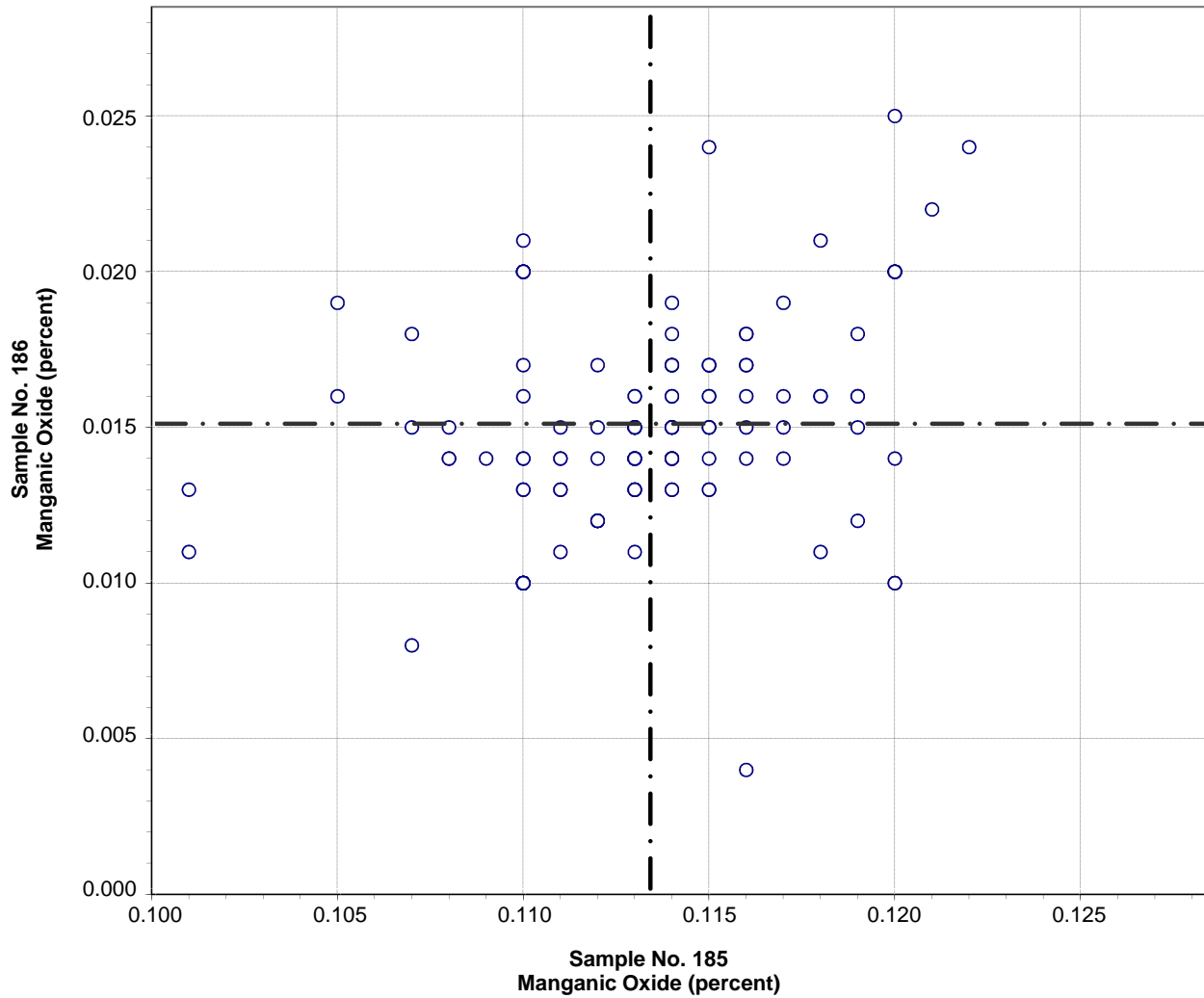
**Test No. 99    Zinc Oxide    84 Points**

Sample No. 185    Ave 0.134    S.D. 0.005    C.V. 4.1  
 Sample No. 186    Ave 0.012    S.D. 0.002    C.V. 18.2

Labs Eliminated: 40, 206, 501, 932, 1466, 2491, 3605

Labs off Diagram: 493, 3752

**CCRL Proficiency Sample Program  
Manganic Oxide  
PORTLAND CEMENT Samples No. 185 and No. 186**

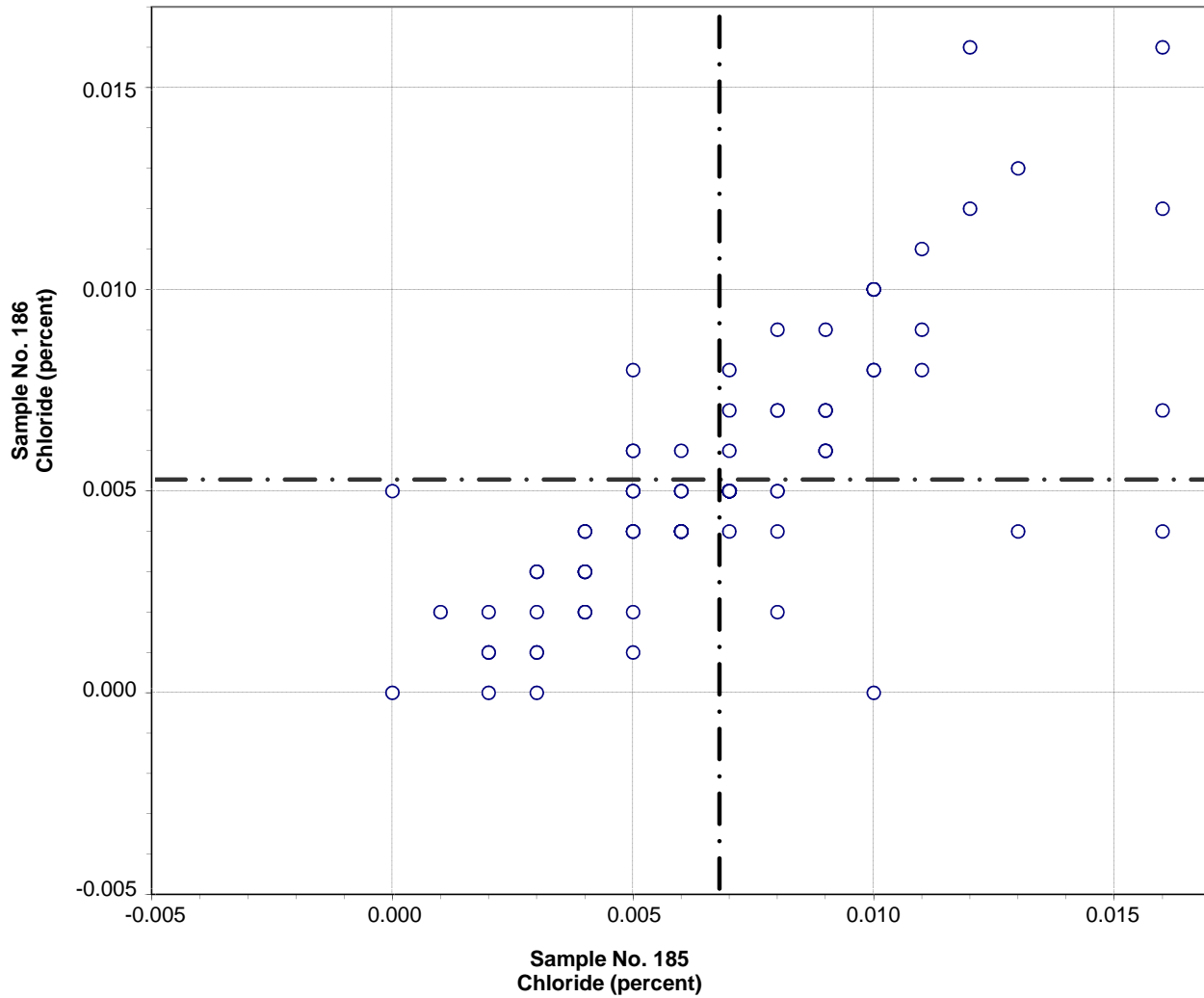


**Test No. 101    Manganic Oxide    127 Points**

Sample No. 185    Ave 0.113    S.D. 0.004    C.V. 3.4  
Sample No. 186    Ave 0.015    S.D. 0.003    C.V. 22.4

Labs Eliminated: 95, 162, 178, 181, 203, 205, 413, 416, 457, 501, 691, 2305,  
2462, 2491, 3057, 3752

**CCRL Proficiency Sample Program  
Chloride  
PORTLAND CEMENT Samples No. 185 and No. 186**

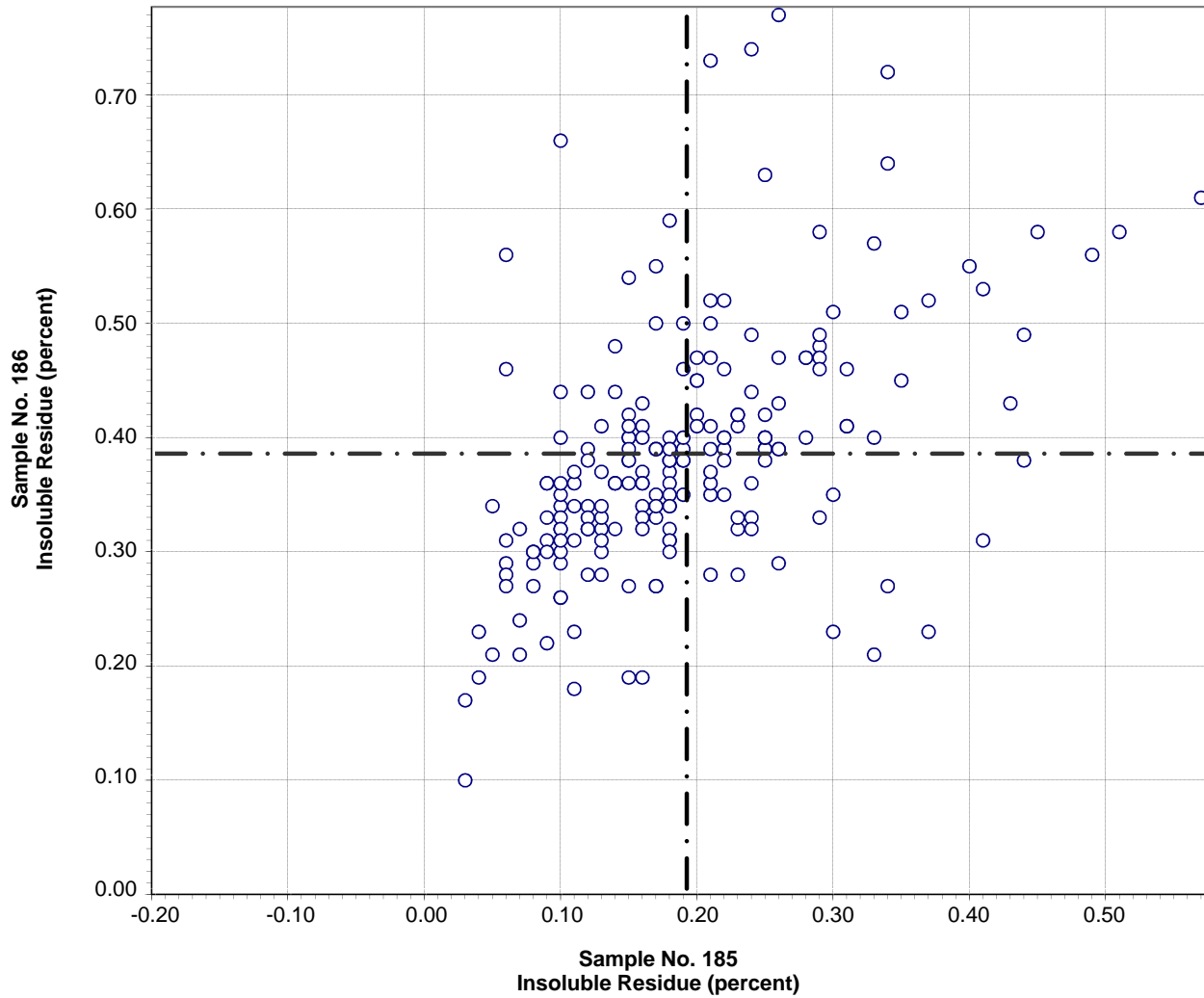


**Test No. 104 Chloride 100 Points**

Sample No. 185 Ave 0.007 S.D. 0.003 C.V. 49  
 Sample No. 186 Ave 0.005 S.D. 0.003 C.V. 60

Labs Eliminated: 129, 158, 684, 692, 696, 768, 886, 1466, 2308, 2491, 3057, 3661

**CCRL Proficiency Sample Program  
Insoluble Residue  
PORTLAND CEMENT Samples No. 185 and No. 186**



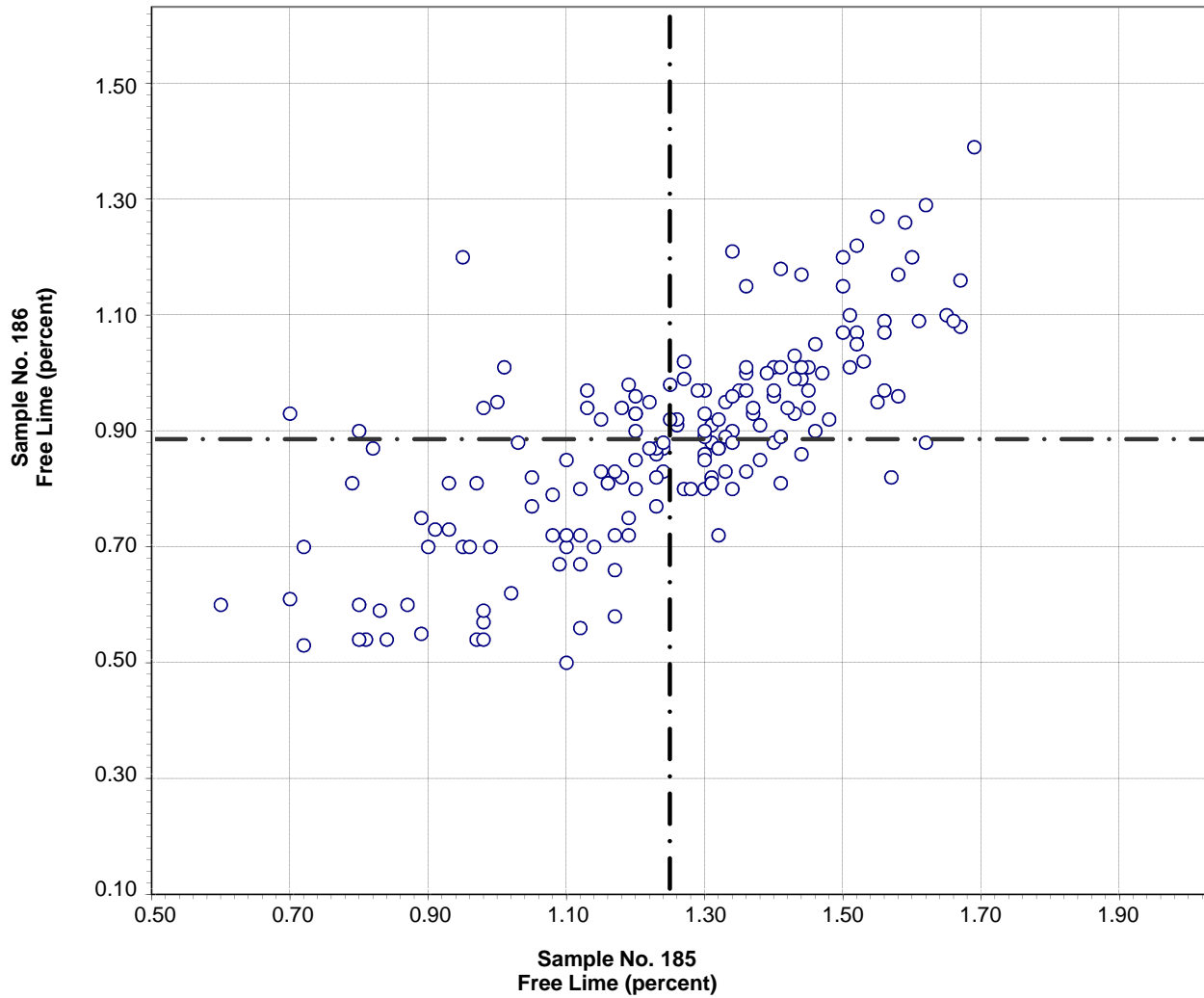
Test No. 80    Insoluble Residue    205 Points

Sample No. 185    Ave 0.19    S.D. 0.10    C.V. 50

Sample No. 186    Ave 0.38    S.D. 0.11    C.V. 28

Labs Eliminated: 51, 134, 206, 222, 413, 497, 687, 840, 2305, 2477

**CCRL Proficiency Sample Program**  
**Free Lime**  
**PORTLAND CEMENT Samples No. 185 and No. 186**



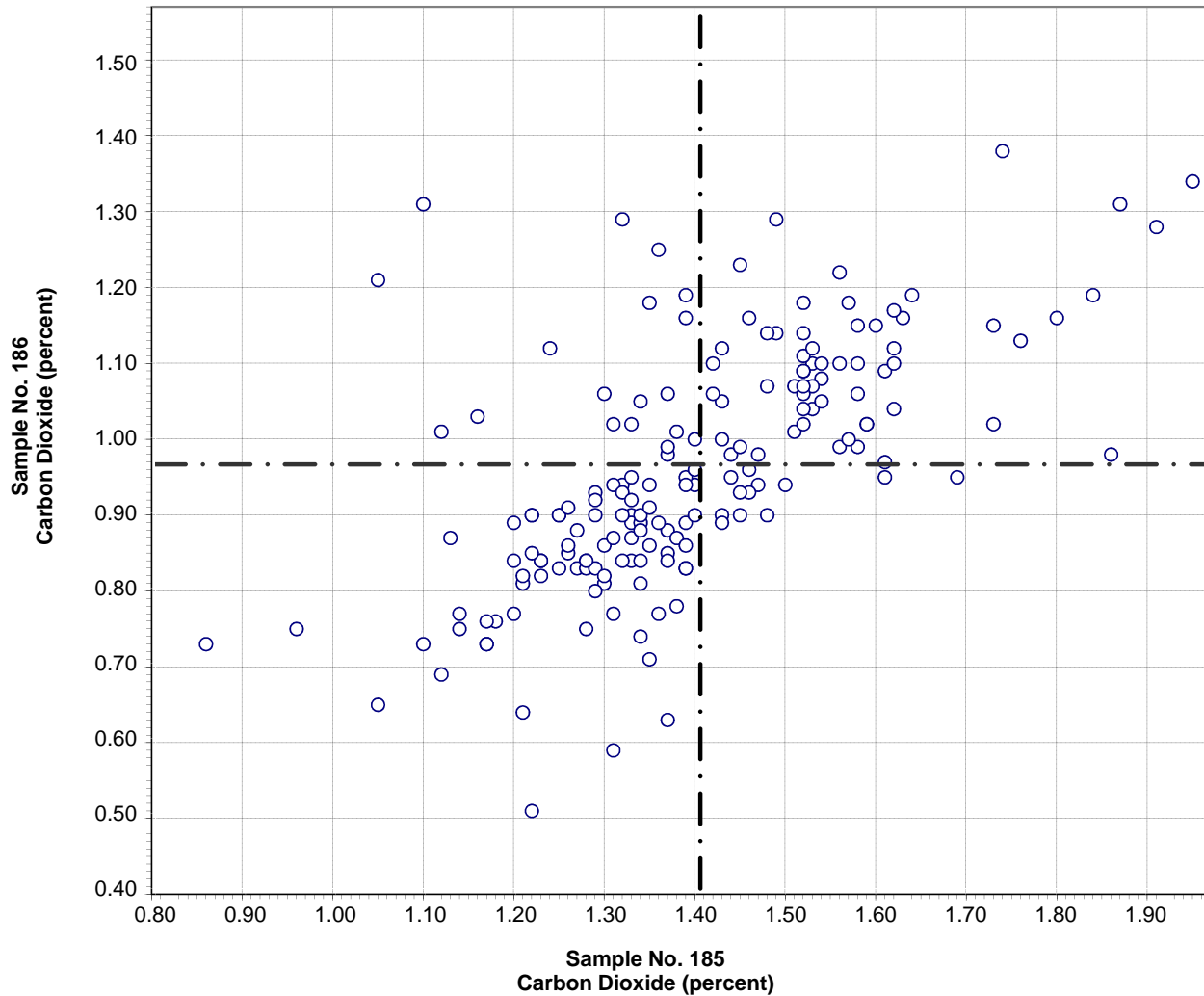
Test No. 41    Free Lime    172 Points

Sample No. 185    Ave 1.25    S.D. 0.23    C.V. 19  
Sample No. 186    Ave 0.88    S.D. 0.17    C.V. 20

Labs Eliminated: 69, 206, 244, 690, 886, 3443



**CCRL Proficiency Sample Program  
Carbon Dioxide  
PORTLAND CEMENT Samples No. 185 and No. 186**



**Test No. 97    Carbon Dioxide    180 Points**

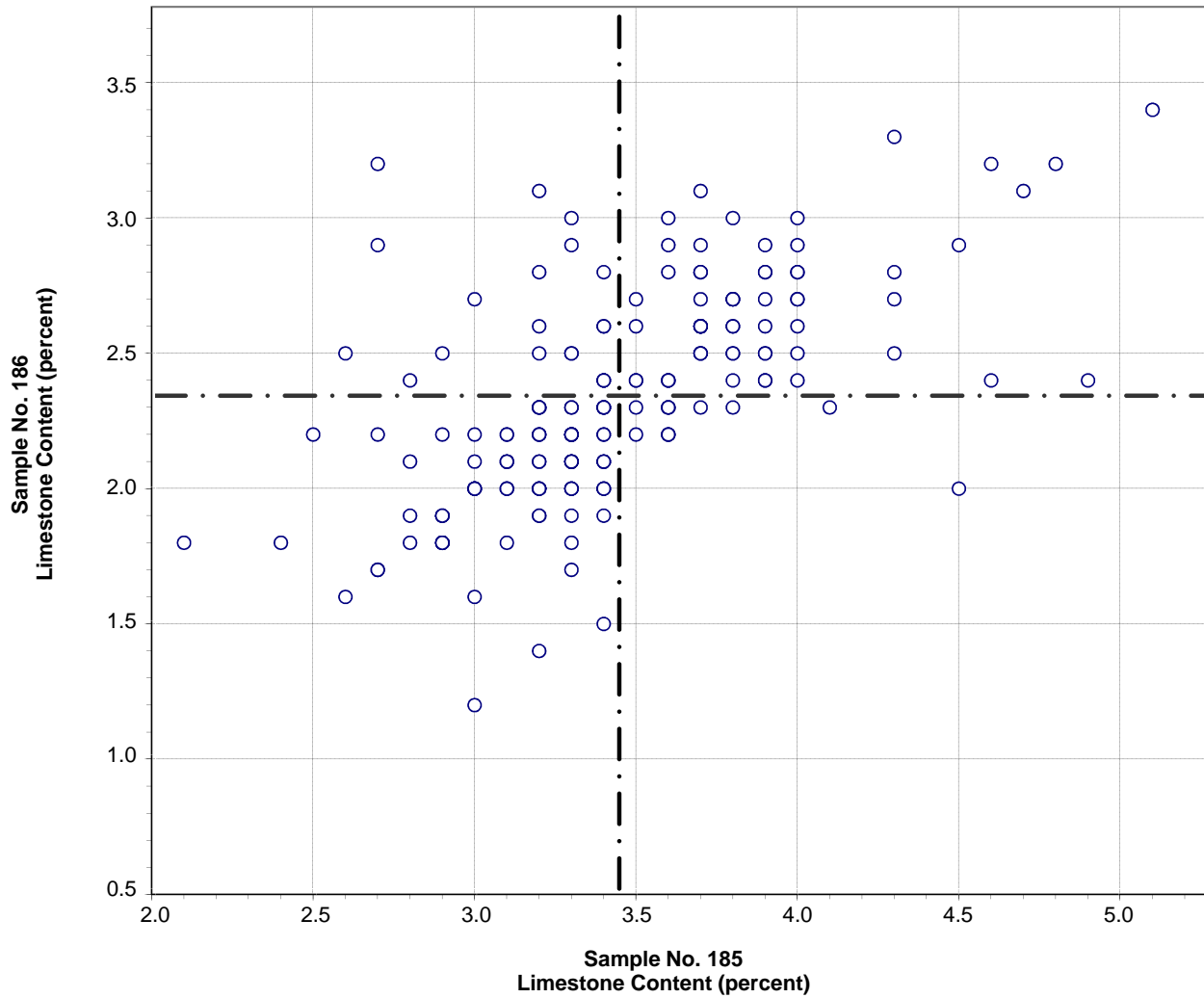
Sample No. 185    Ave 1.41    S.D. 0.19    C.V. 13.4

Sample No. 186    Ave 0.96    S.D. 0.16    C.V. 16.6

Labs Eliminated: 56, 94, 95, 129, 132, 137, 181, 221, 415, 886, 1715, 2491, 3233,  
3279, 3752

Labs off Diagram: 60, 159

**CCRL Proficiency Sample Program  
Limestone Content  
PORTLAND CEMENT Samples No. 185 and No. 186**



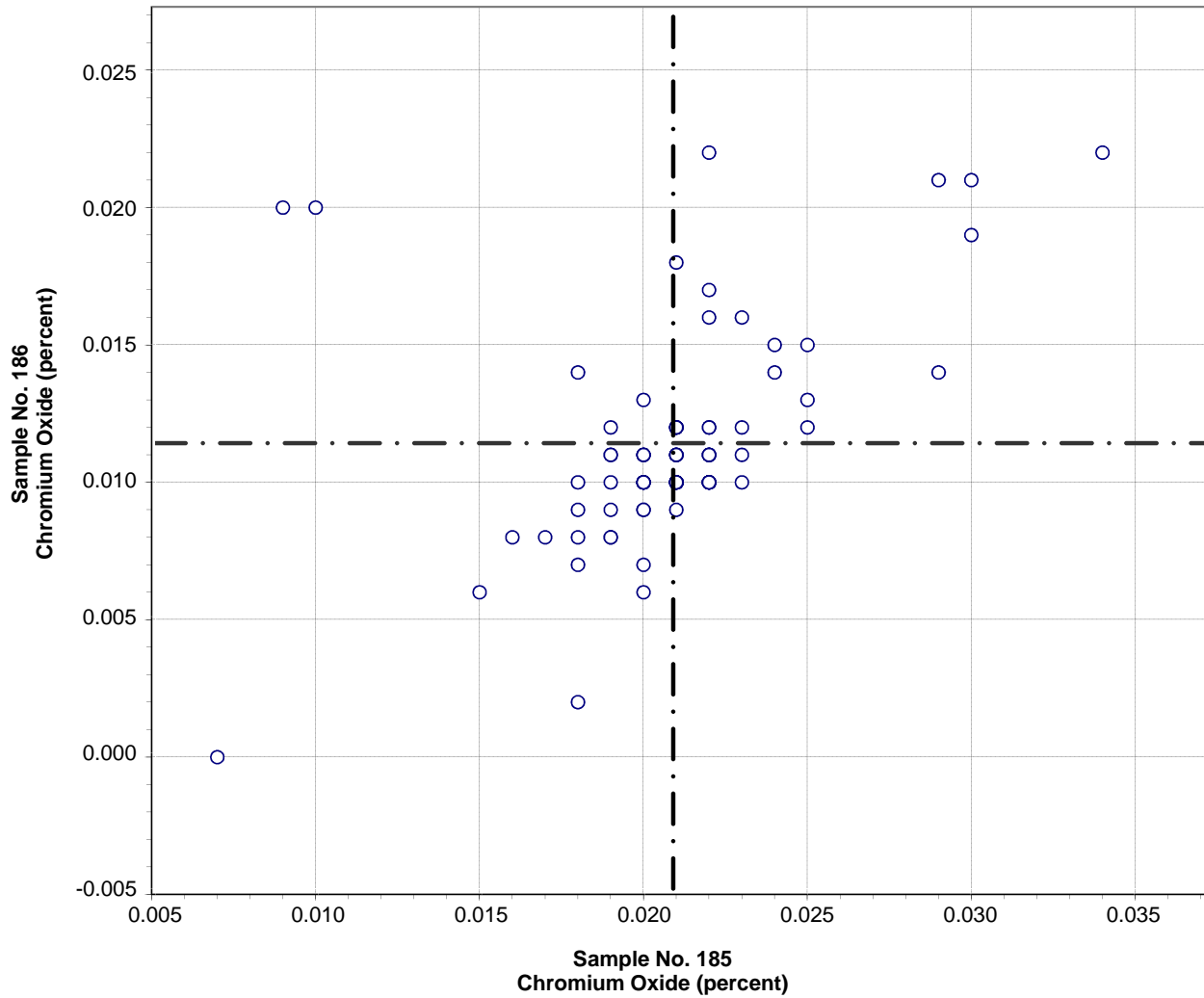
**Test No. 98    Limestone Content    180 Points**

Sample No. 185    Ave 3.4    S.D. 0.5    C.V. 13.9

Sample No. 186    Ave 2.3    S.D. 0.4    C.V. 16.8

Labs Eliminated: 56, 95, 129, 132, 137, 181, 221, 415, 886, 1079, 1715, 2477,  
2484, 2491, 3279, 3752

CCRL Proficiency Sample Program  
Chromium Oxide  
PORTLAND CEMENT Samples No. 185 and No. 186

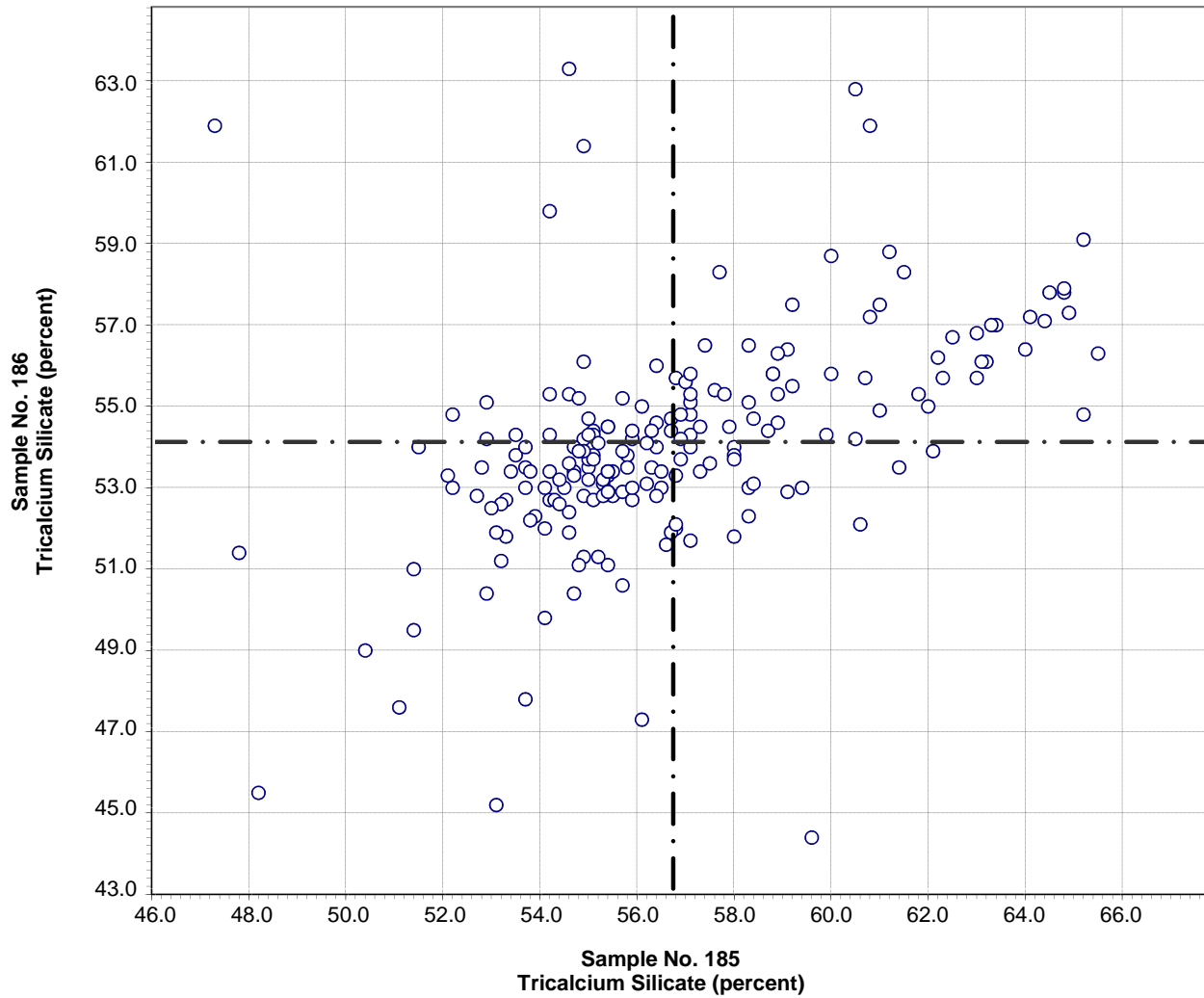


Test No. 105 Chromium Oxide 84 Points

Sample No. 185 Ave 0.021 S.D. 0.004 C.V. 18  
Sample No. 186 Ave 0.011 S.D. 0.004 C.V. 34

Labs Eliminated: 15, 157, 438, 2491, 3752

**CCRL Proficiency Sample Program  
Tricalcium Silicate  
PORTLAND CEMENT Samples No. 185 and No. 186**



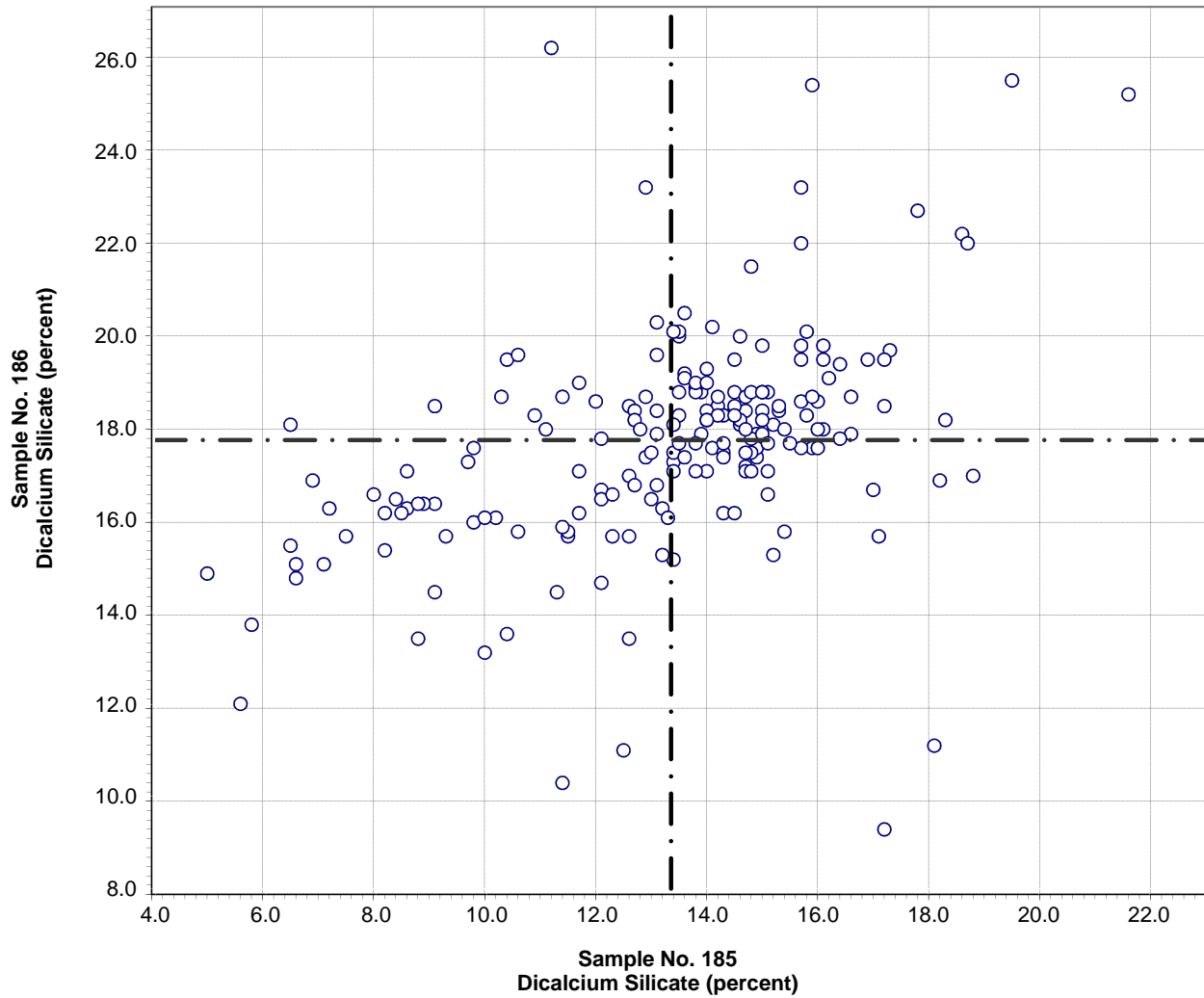
Test No. 106    Tricalcium Silicate    195 Points

Sample No. 185    Ave 56.7    S.D. 3.5    C.V. 6.1

Sample No. 186    Ave 54.1    S.D. 2.7    C.V. 4.9

Labs Eliminated: 50, 1525, 2477, 2621, 3415

**CCRL Proficiency Sample Program  
Dicalcium Silicate  
PORTLAND CEMENT Samples No. 185 and No. 186**



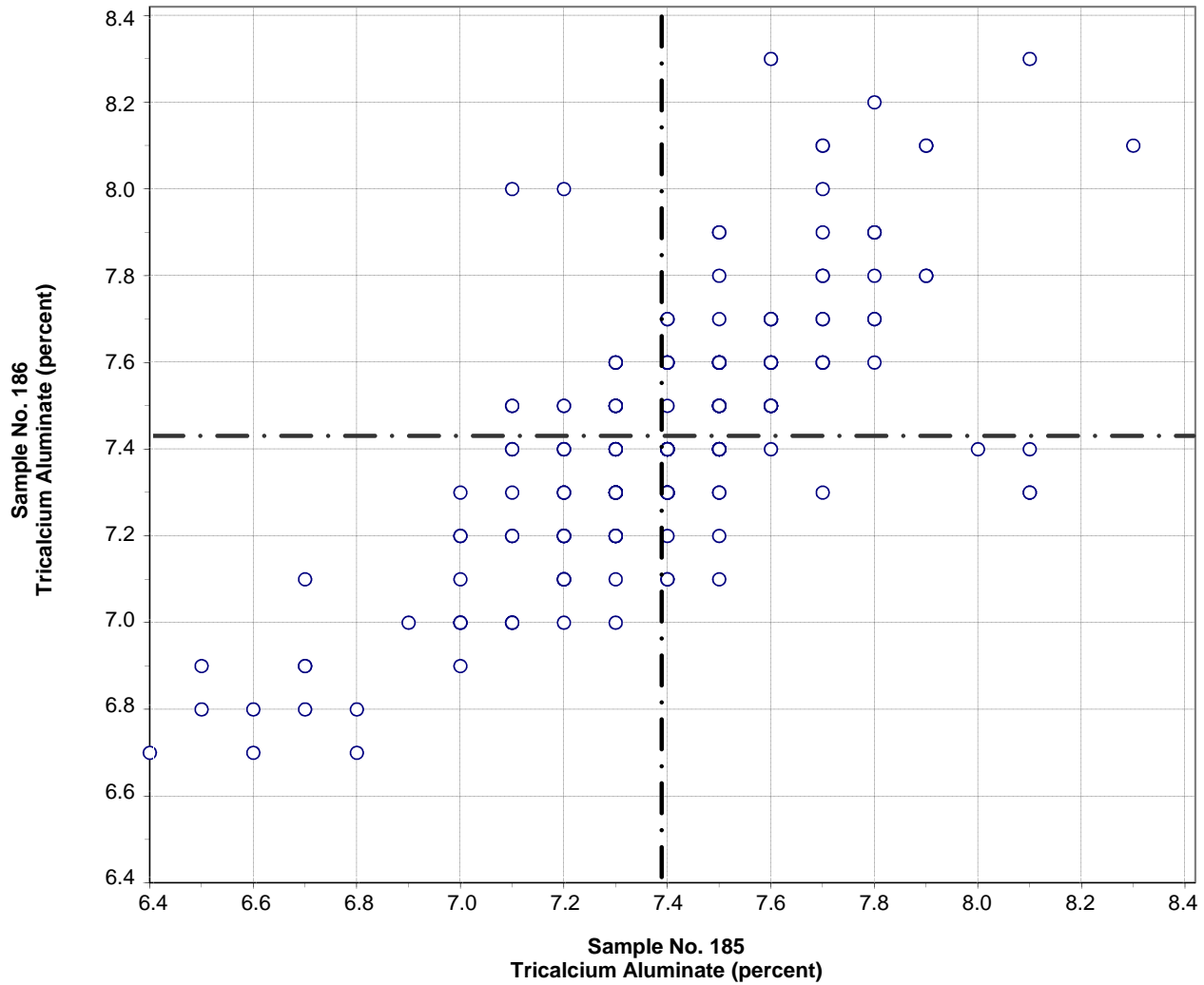
**Test No. 107    Dicalcium Silicate    194 Points**

Sample No. 185    Ave 13.3    S.D. 2.9    C.V. 22.0

Sample No. 186    Ave 17.7    S.D. 2.3    C.V. 13.2

Labs Eliminated: 50, 1525, 1526, 2621, 3415

**CCRL Proficiency Sample Program  
Tricalcium Aluminate  
PORTLAND CEMENT Samples No. 185 and No. 186**



Test No. 108    Tricalcium Aluminate    194 Points

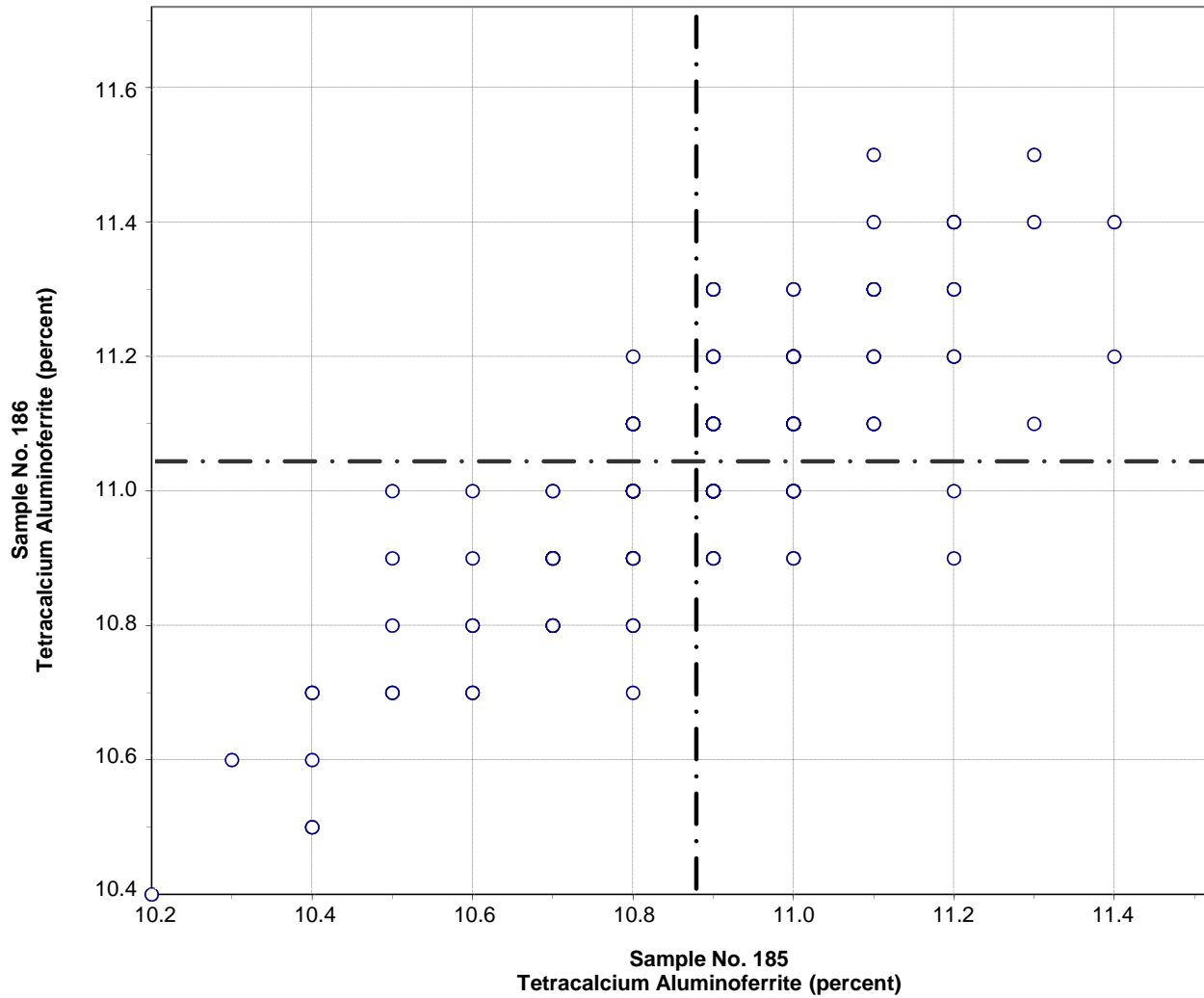
Sample No. 185    Ave 7.4    S.D. 0.3    C.V. 4.3

Sample No. 186    Ave 7.4    S.D. 0.3    C.V. 4.1

Labs Eliminated: 40, 1525, 1715

Labs off Diagram: 255, 3606

**CCRL Proficiency Sample Program  
Tetracalcium Aluminoferrite  
PORTLAND CEMENT Samples No. 185 and No. 186**



**Test No. 109    Tetracalcium Aluminoferrite    192 Points**

Sample No. 185    Ave 10.9    S.D. 0.2    C.V. 1.8

Sample No. 186    Ave 11.0    S.D. 0.2    C.V. 1.7

Labs Eliminated: 157, 457, 687, 1715, 2251, 3279

Labs off Diagram: 1525

**CCRL PROFICIENCY SAMPLE PROGRAM**  
 Portland Cement Proficiency Samples No. 185 and No. 186

Final Report – Physical Results  
 August 31, 2012

SUMMARY OF RESULTS

Sample No.185

Sample No. 186

Test (unit)	#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.
<b>Normal Consistency - % Water (percent)</b>							
	243	26.2	9.06	34.60	26.5	9.10	34.40
	*235	25.7	0.42	1.60	26.0	0.41	1.60
* Labs Eliminated - 5, 40, 47, 148, 565, 1940, 2490, 3658							
<b>Vicat Time of Set - Initial (minutes)</b>							
	239	129	15	11	111	12	11
	*233	130	13	10	111	11	10
* Labs Eliminated - 5, 25, 39, 40, 247, 690							
<b>Vicat Time of Set - Final (minutes)</b>							
	229	239	34	14	219	32	15
	*225	240	31	13	219	30	14
* Labs Eliminated - 25, 40, 1483, 3658							
<b>Gillmore Time of Set - Initial (minutes)</b>							
	145	172	27	16	154	26	17
	*143	171	26	15	153	24	16
* Labs Eliminated - 126, 176							
<b>Gillmore Time of Set - Final (minutes)</b>							
	145	276	39	14	251	39	16
	*144	275	36	13	250	37	15
* Labs Eliminated - 46							
<b>False Set - Paste Method (percent)</b>							
	196	78	8.5	10.9	76	9.3	12.3
	*193	78	7.9	10.1	76	8.9	11.7
* Labs Eliminated - 49, 1657, 2463							
<b>Autoclave Expansion (percent)</b>							
	220	-0.01	0.019	100	-0.00	0.026	352
	*207	-0.02	0.013	59	-0.01	0.013	143
* Labs Eliminated - 34, 51, 105, 146, 157, 243, 416, 687, 690, 2462, 3607, 3662, 3752							



**CCRL PROFICIENCY SAMPLE PROGRAM**  
 Portland Cement Proficiency Samples No. 185 and No. 186

Final Report – Physical Results  
 August 31, 2012

SUMMARY OF RESULTS

Sample No.185

Sample No. 186

Test (unit)	#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.
<b>Air Content % (percent)</b>							
	217	7.3	1.3	18	7.3	1.3	18
	*214	7.4	1.3	18	7.3	1.2	17
* Labs Eliminated - 360, 2490, 3695							
<b>Air Content - % Water (percent)</b>							
	214	69.5	18.6	26.7	69.5	18.7	27.0
	*199	68.9	2.2	3.2	68.9	2.1	3.0
* Labs Eliminated - 47, 49, 75, 84, 105, 148, 165, 169, 360, 779, 1054, 2490, 3144, 3297, 3695							
<b>Air Content - Flow (percent)</b>							
	214	88	4.4	4.9	88	4.1	4.6
	*209	88	3.5	4.0	88	3.3	3.7
* Labs Eliminated - 40, 86, 125, 152, 243							
<b>Compressive Strength - 3 day (psi)</b>							
	248	3618	287	7.9	3822	299	7.8
	*243	3629	258	7.1	3831	270	7.0
* Labs Eliminated - 48, 51, 1435, 1525, 1526							
<b>Compressive Strength - 7 day (psi)</b>							
	247	4710	340	7.2	5029	380	7.6
	*242	4706	318	6.8	5018	332	6.6
* Labs Eliminated - 26, 48, 51, 205, 694							
<b>Compressive Strength - 28 day (psi)</b>							
	231	6496	438	6.7	6632	448	6.8
	*227	6511	398	6.1	6648	392	5.9
* Labs Eliminated - 51, 694, 840, 2360							
<b>Compressive Strength - Flow (percent)</b>							
	226	113	12	10.6	112	12	10.6
	*218	114	9	8.0	114	9	8.0
* Labs Eliminated - 9, 34, 47, 49, 129, 222, 360, 3695							

**CCRL PROFICIENCY SAMPLE PROGRAM**  
 Portland Cement Proficiency Samples No. 185 and No. 186

Final Report – Physical Results  
 August 31, 2012

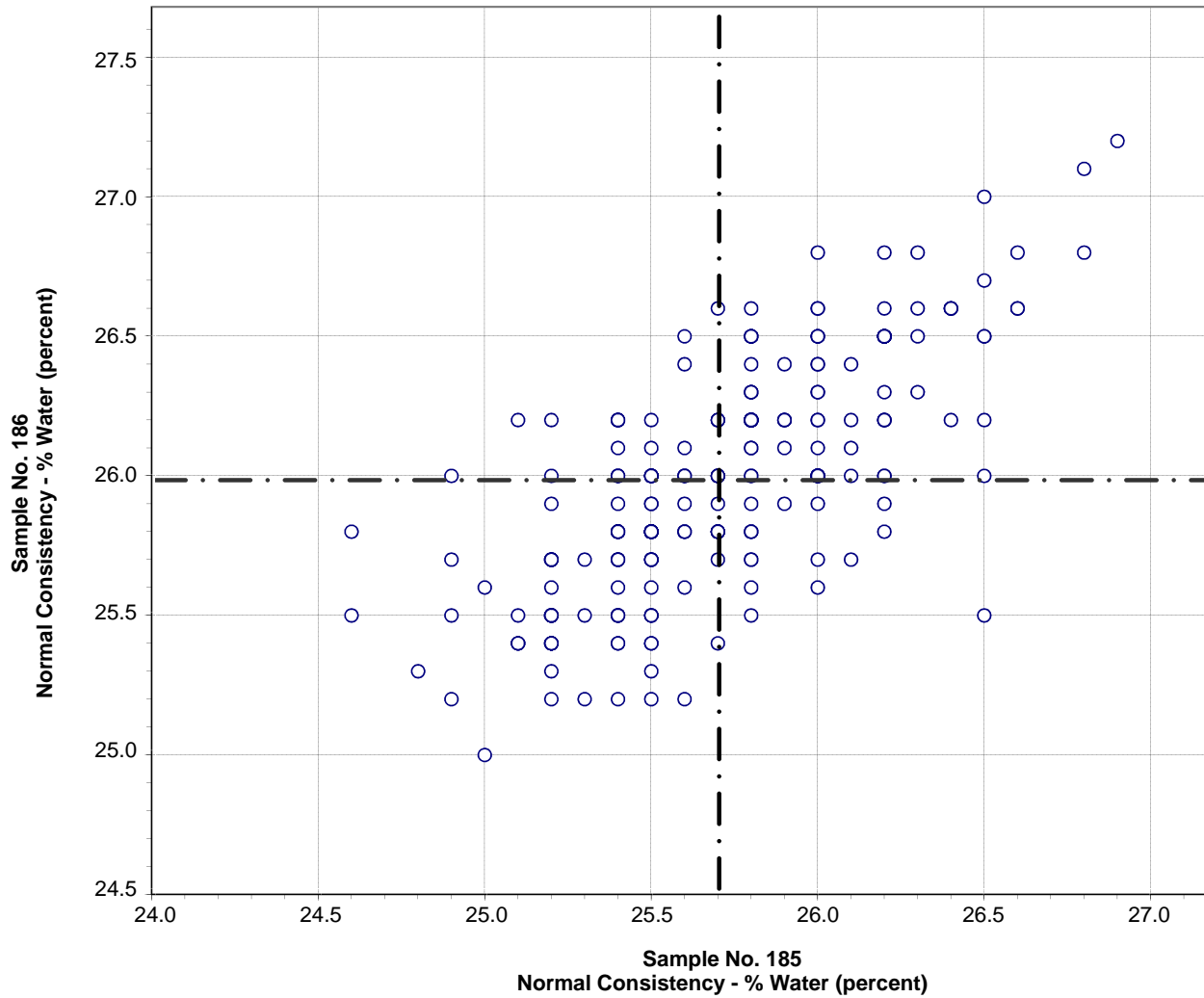
SUMMARY OF RESULTS

Sample No.185

Sample No. 186

Test (unit)	#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.
<b>Fineness - Air Permeability (m<sup>2</sup>/kg)</b>							
	242	392	11	2.9	400	17	4.2
	*236	393	9	2.4	400	10	2.5
* Labs Eliminated - 40, 49, 103, 207, 958, 3511							
<b>Fineness - Wagner Turbidimeter (cm<sup>2</sup>/g)</b>							
	7	236	72	30.5	250	68	27.2
	*6	209	11	5.3	224	7	3.1
* Labs Eliminated - 1526							
<b>Fineness - 45µm Sieve (percent)</b>							
	229	96.42	0.80	0.8	97.57	2.97	3
	*220	96.50	0.54	0.6	97.82	0.40	0.4
* Labs Eliminated - 29, 40, 51, 70, 94, 95, 413, 415, 1435							
<b>C1038 Mortar Bar Expansion (percent)</b>							
	149	0.002	0.027	1238	0.004	0.016	429
	*140	0.003	0.004	136	0.004	0.004	103
* Labs Eliminated - 34, 51, 125, 497, 565, 1466, 3057, 3279, 3658							
<b>C1038 Mortar - Water (ml)</b>							
	145	240	14	5.8	240	14	5.8
	*140	240	5	2.3	240	5	2.1
* Labs Eliminated - 34, 123, 497, 565, 2462							
<b>C1038 Mortar - Flow (percent)</b>							
	144	110	4	3.5	110	4	4.0
	*137	110	3	2.3	110	2	2.2
* Labs Eliminated - 46, 99, 491, 497, 2412, 3605, 3607							

**CCRL Proficiency Sample Program  
Normal Consistency - % Water  
PORTLAND CEMENT Samples No. 185 and No. 186**



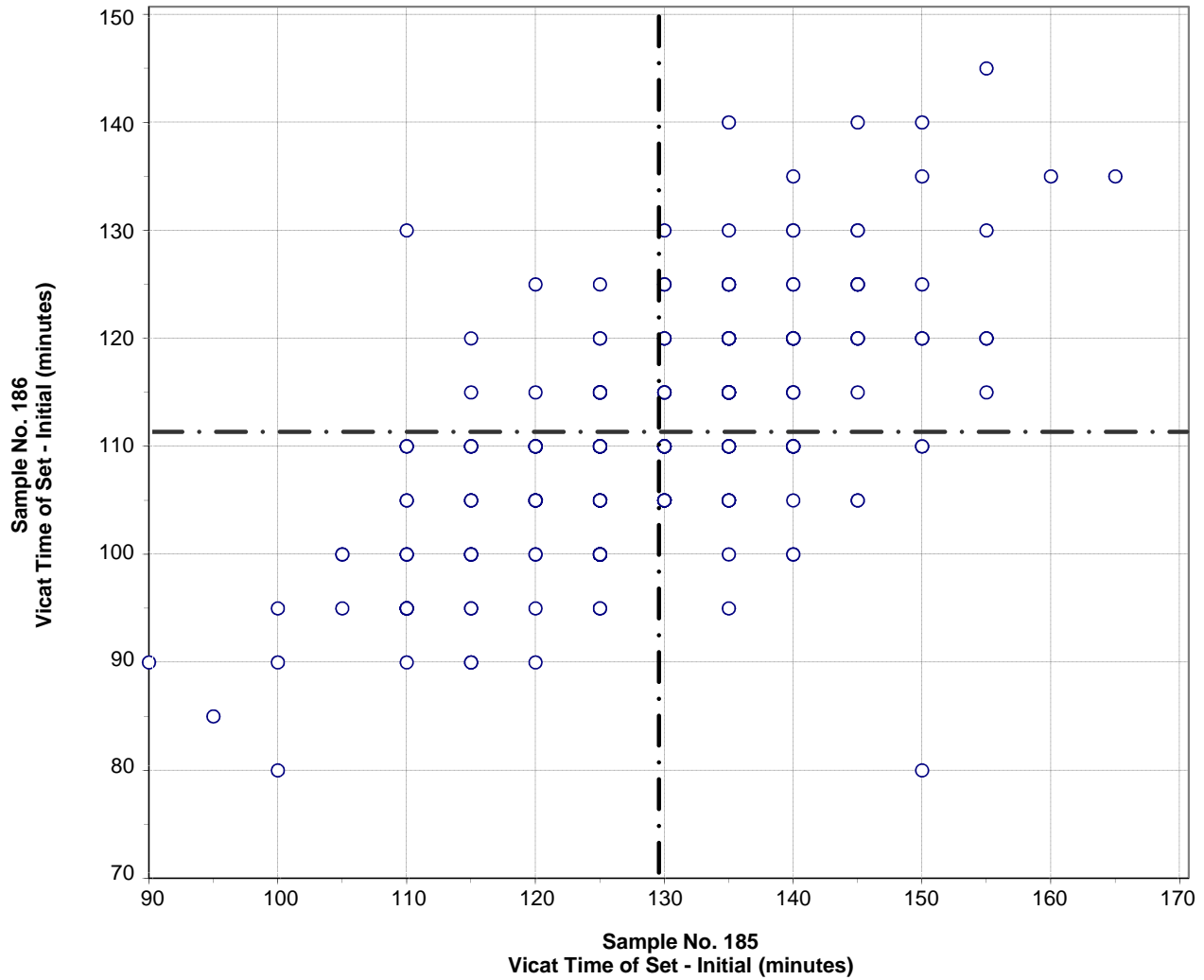
**Test No. 110    Normal Consistency - % Water    235 Points**

Sample No. 185    Ave 25.7    S.D. 0.42    C.V. 1.60

Sample No. 186    Ave 26.0    S.D. 0.41    C.V. 1.60

Labs Eliminated: 5, 40, 47, 148, 565, 1940, 2490, 3658

**CCRL Proficiency Sample Program  
 Vicat Time of Set - Initial  
 PORTLAND CEMENT Samples No. 185 and No. 186**



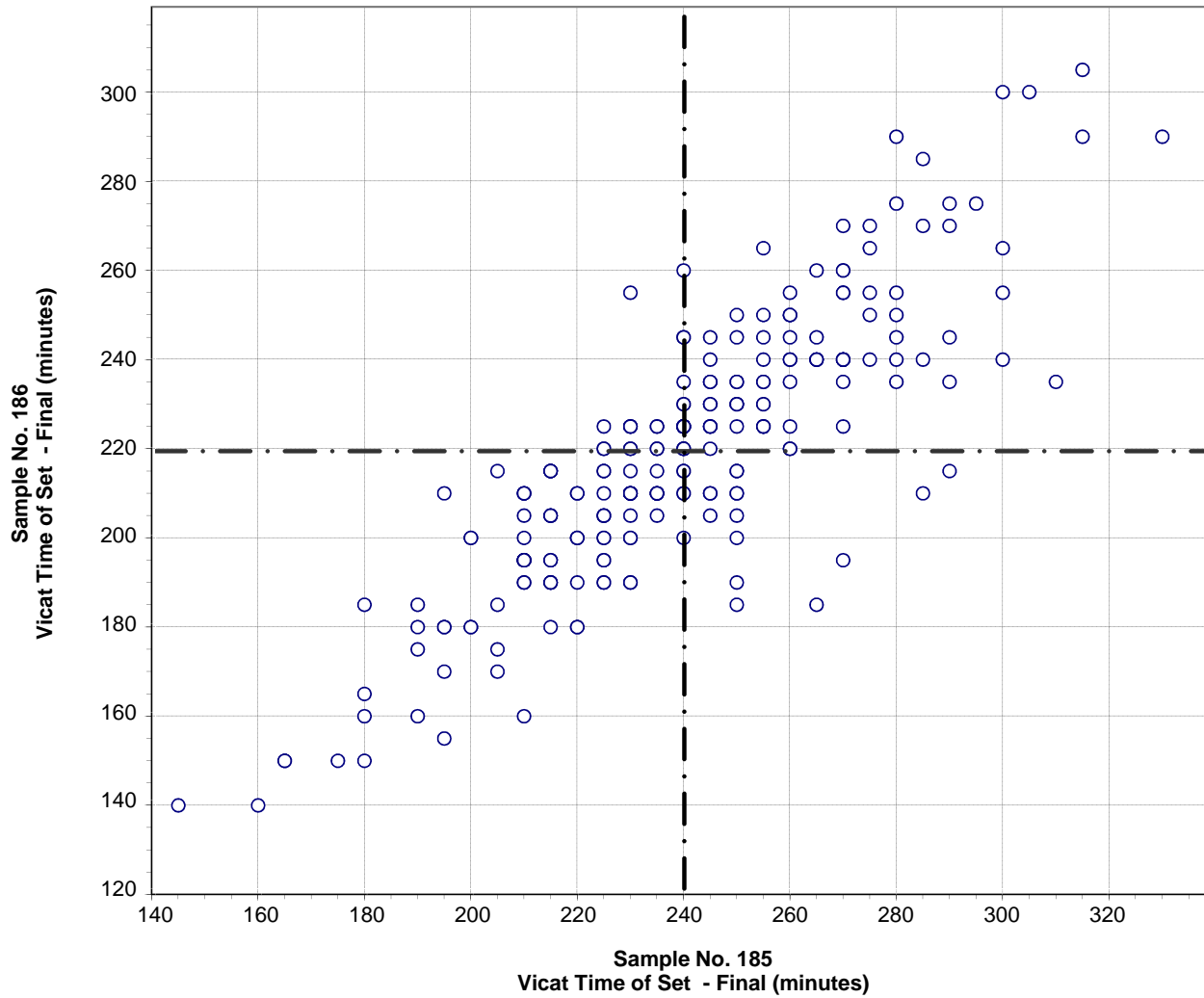
**Test No. 120    Vicat Time of Set - Initial    233 Points**

Sample No. 185    Ave 130    S.D. 13    C.V. 10

Sample No. 186    Ave 111    S.D. 11    C.V. 10

Labs Eliminated: 5, 25, 39, 40, 247, 690

**CCRL Proficiency Sample Program  
 Vicat Time of Set - Final  
 PORTLAND CEMENT Samples No. 185 and No. 186**



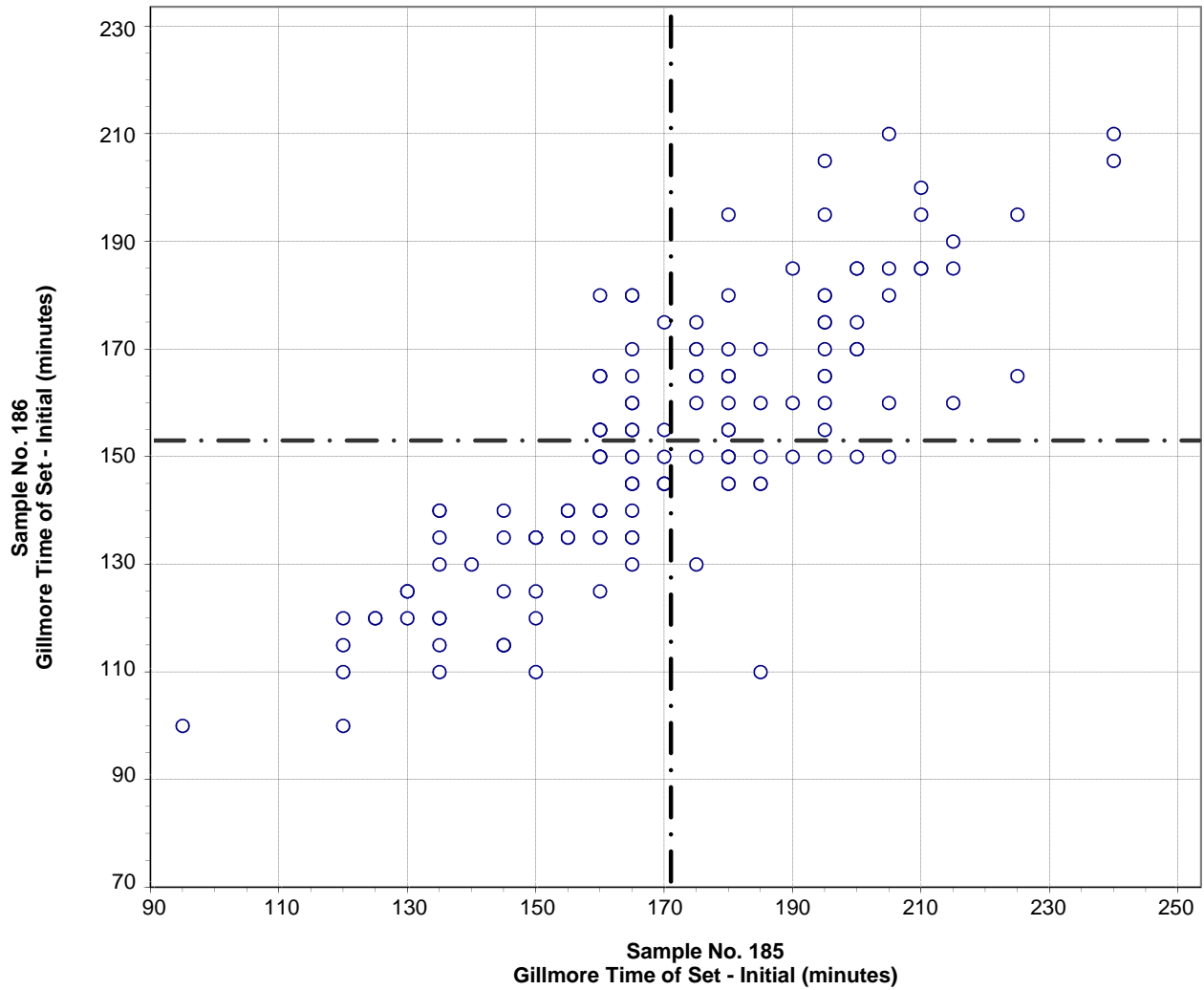
**Test No. 121    Vicat Time of Set - Final    225 Points**

Sample No. 185    Ave 240    S.D. 31    C.V. 13

Sample No. 186    Ave 219    S.D. 30    C.V. 14

Labs Eliminated: 25, 40, 1483, 3658

**CCRL Proficiency Sample Program  
Gillmore Time of Set - Initial  
PORTLAND CEMENT Samples No. 185 and No. 186**

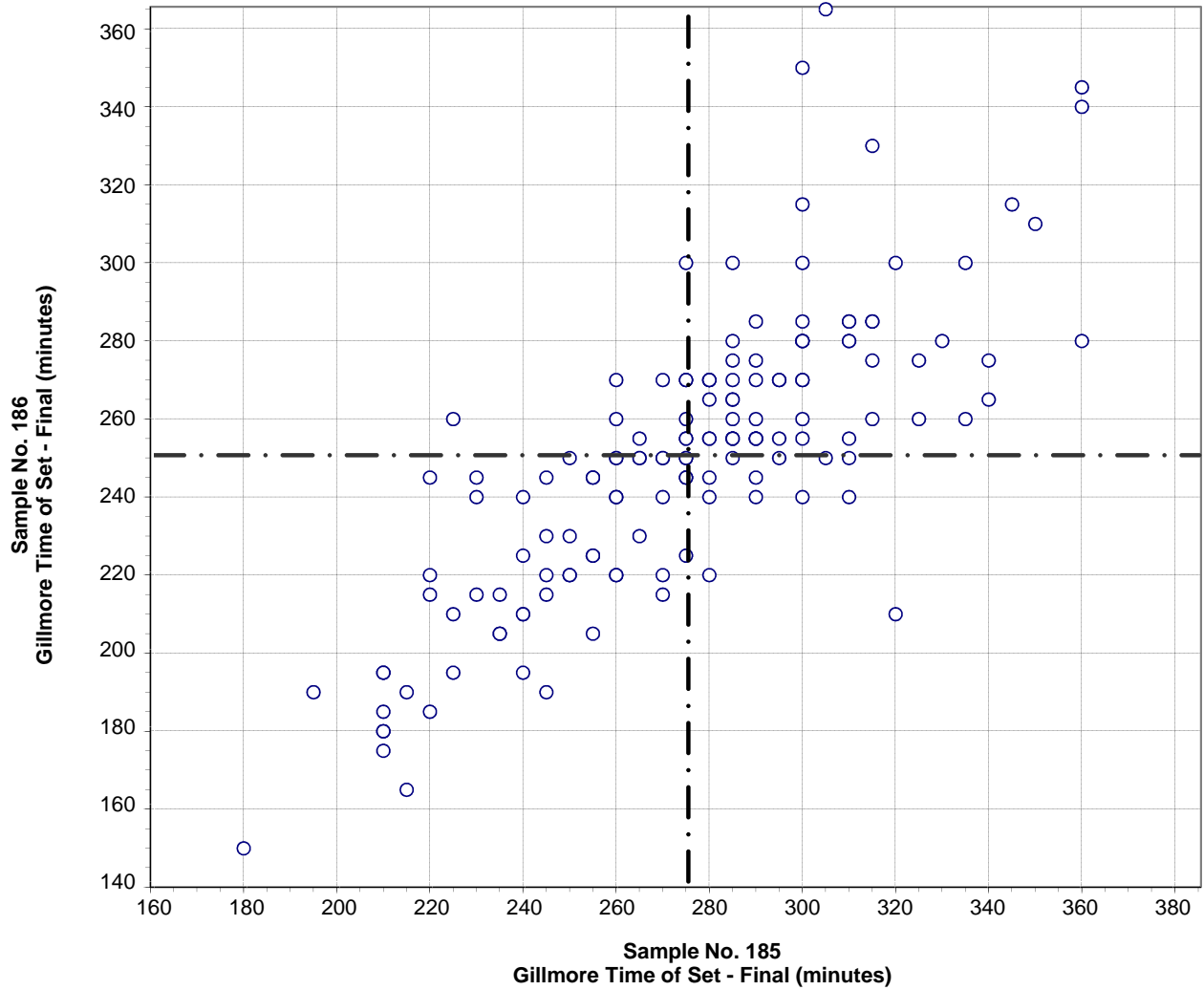


**Test No. 130 Gillmore Time of Set - Initial 143 Points**

Sample No. 185 Ave 171 S.D. 26 C.V. 15  
 Sample No. 186 Ave 153 S.D. 24 C.V. 16

Labs Eliminated: 126, 176

**CCRL Proficiency Sample Program  
Gillmore Time of Set - Final  
PORTLAND CEMENT Samples No. 185 and No. 186**

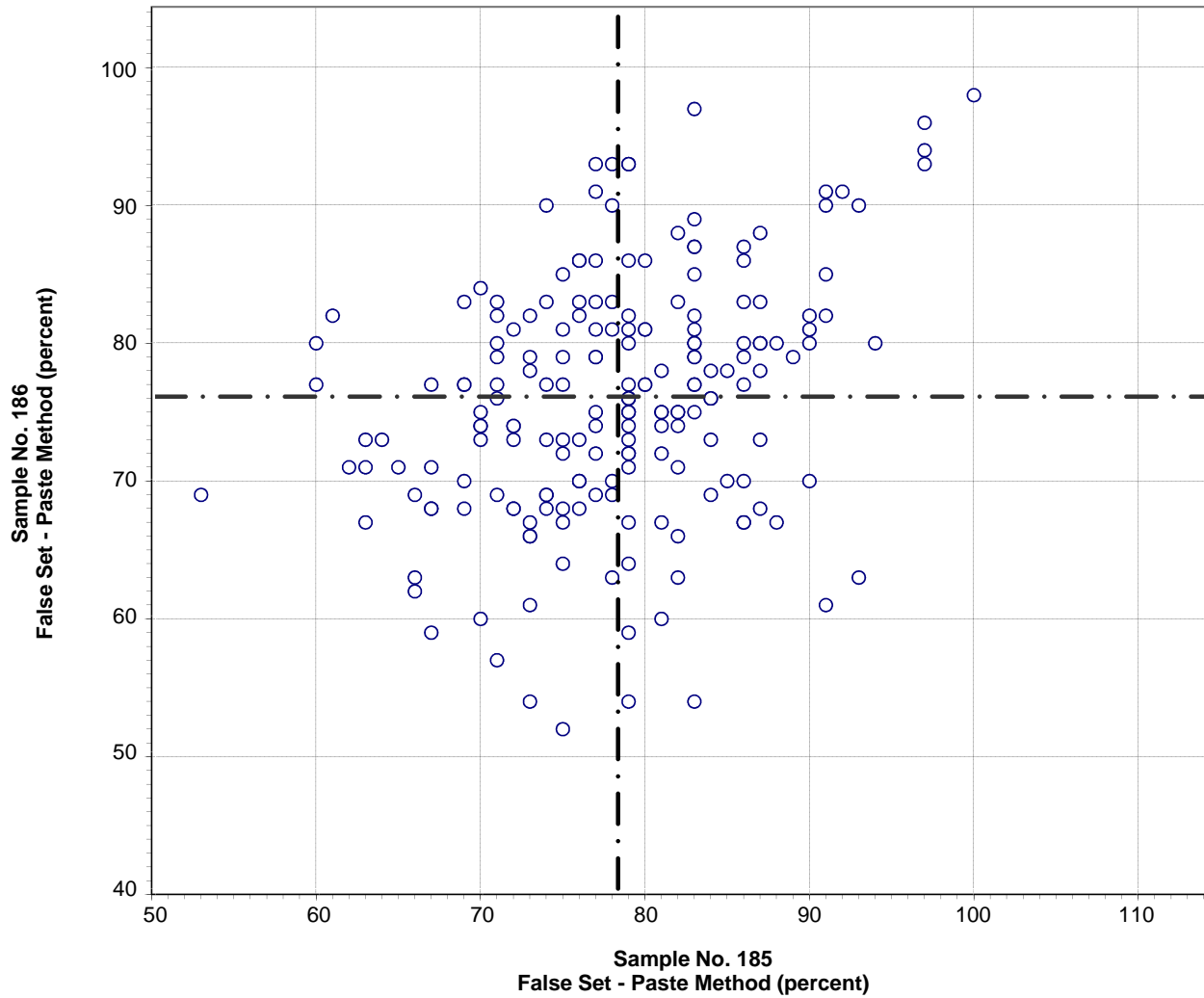


**Test No. 140    Gillmore Time of Set - Final    144 Points**

Sample No. 185    Ave 275    S.D. 36    C.V. 13  
 Sample No. 186    Ave 250    S.D. 37    C.V. 15

Labs Eliminated: 46

**CCRL Proficiency Sample Program  
False Set - Paste Method  
PORTLAND CEMENT Samples No. 185 and No. 186**



**Test No. 150    False Set - Paste Method    193 Points**

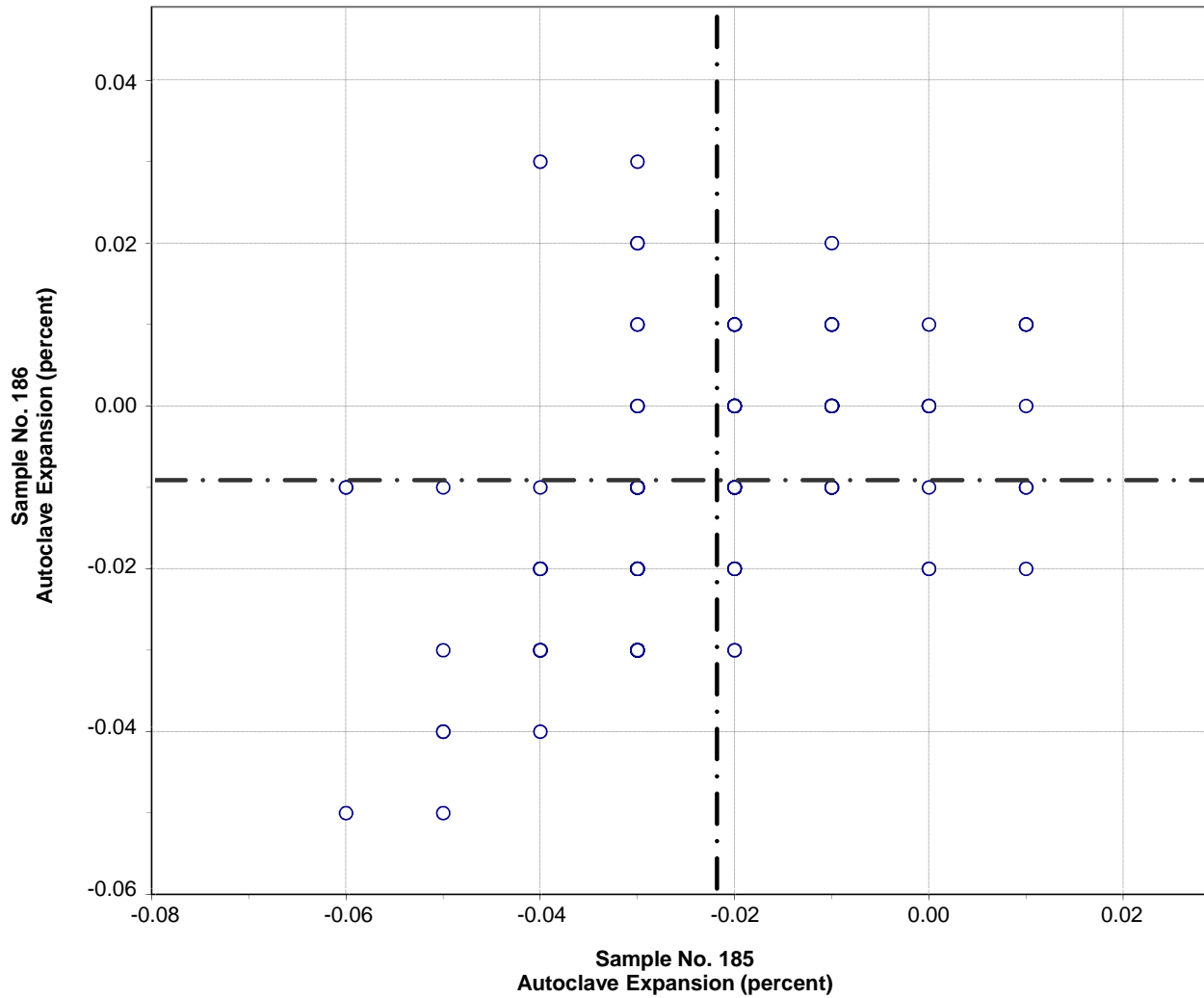
Sample No. 185    Ave 78    S.D. 7.9    C.V. 10.1

Sample No. 186    Ave 76    S.D. 8.9    C.V. 11.7

Labs Eliminated: 49, 1657, 2463



**CCRL Proficiency Sample Program  
Autoclave Expansion  
PORTLAND CEMENT Samples No. 185 and No. 186**

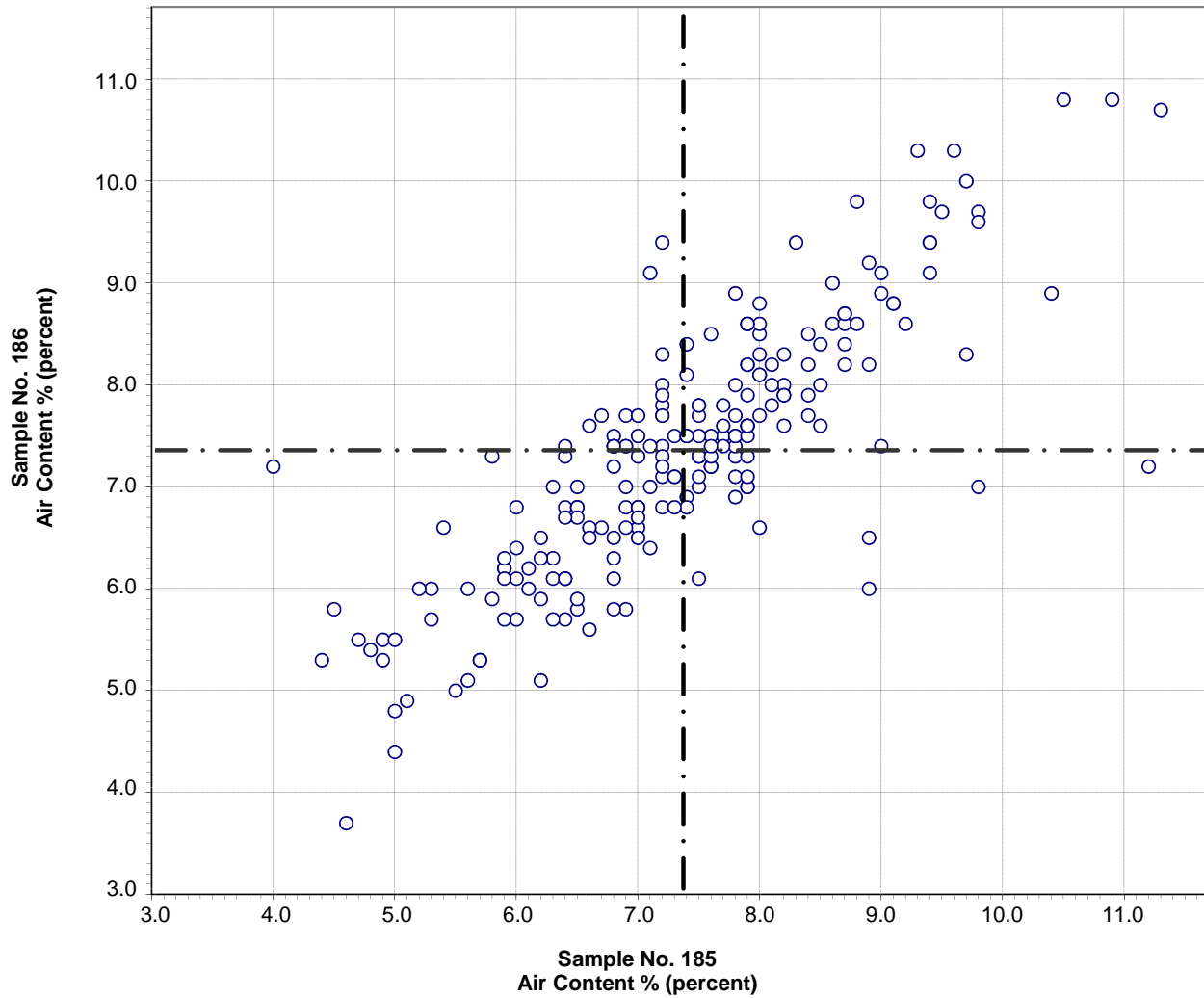


**Test No. 160    Autoclave Expansion    207 Points**

Sample No. 185    Ave -0.02    S.D. 0.013    C.V. 59  
 Sample No. 186    Ave -0.01    S.D. 0.013    C.V. 143

Labs Eliminated: 34, 51, 105, 146, 157, 243, 416, 687, 690, 2462, 3607, 3662, 3752

**CCRL Proficiency Sample Program**  
**Air Content %**  
**PORTLAND CEMENT Samples No. 185 and No. 186**



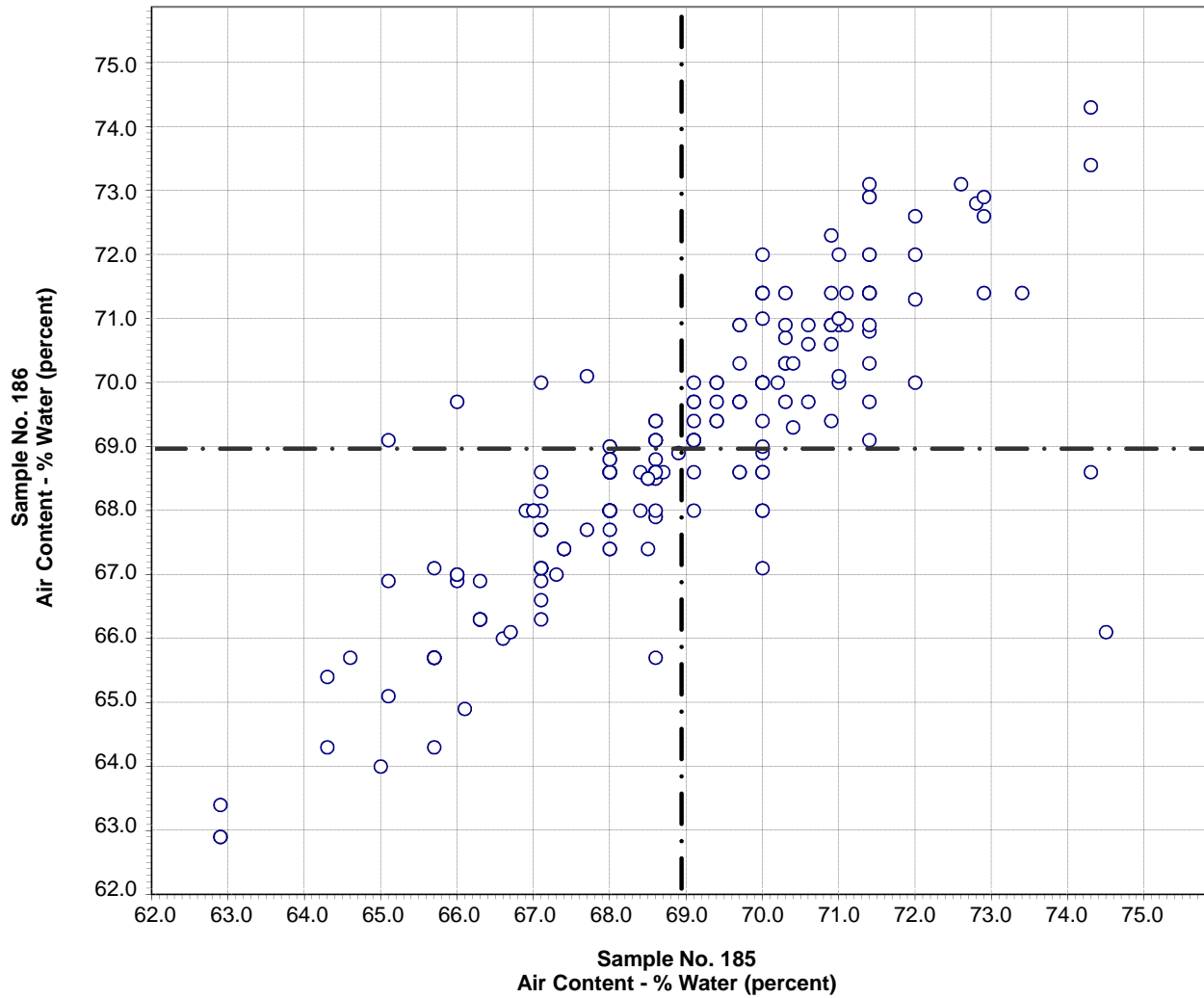
**Test No. 170    Air Content %    214 Points**

Sample No. 185    Ave 7.4    S.D. 1.3    C.V. 18

Sample No. 186    Ave 7.3    S.D. 1.2    C.V. 17

Labs Eliminated: 360, 2490, 3695

**CCRL Proficiency Sample Program  
Air Content - % Water  
PORTLAND CEMENT Samples No. 185 and No. 186**



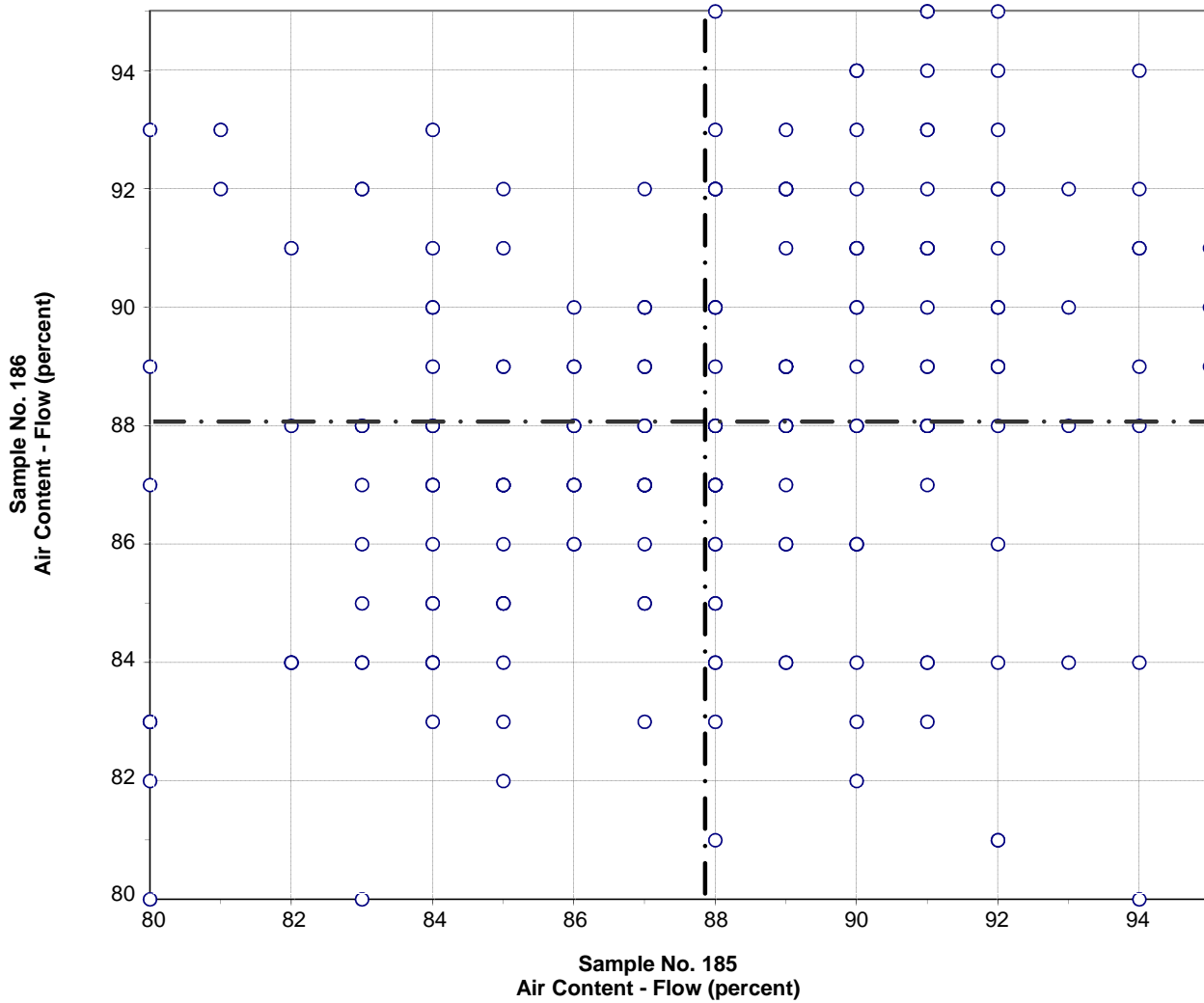
**Test No. 180 Air Content - % Water 199 Points**

Sample No. 185 Ave 68.9 S.D. 2.2 C.V. 3.2

Sample No. 186 Ave 68.9 S.D. 2.1 C.V. 3.0

Labs Eliminated: 47, 49, 75, 84, 105, 148, 165, 169, 360, 779, 1054, 2490, 3144, 3297, 3695

**CCRL Proficiency Sample Program  
Air Content - Flow  
PORTLAND CEMENT Samples No. 185 and No. 186**



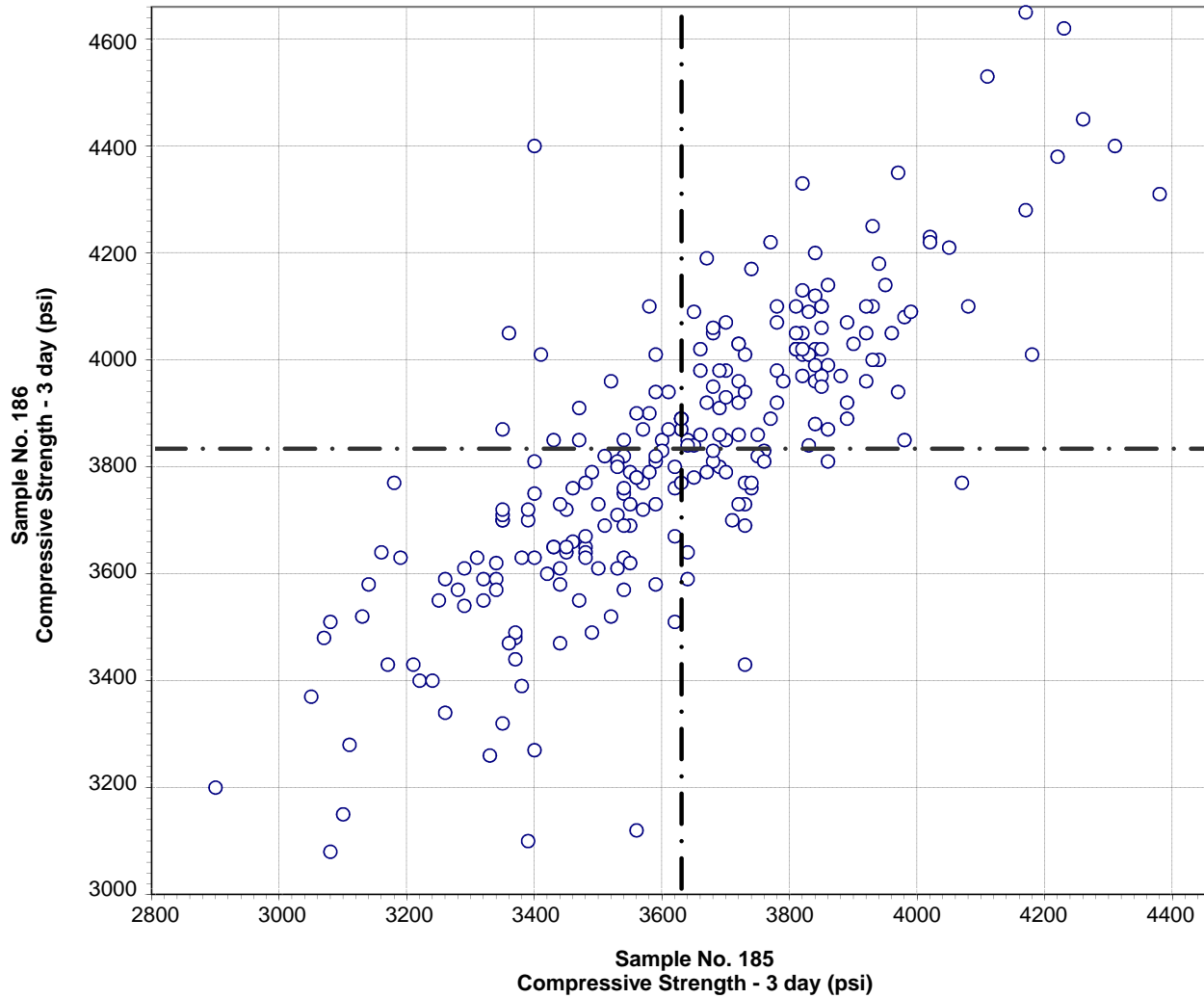
**Test No. 190    Air Content - Flow    209 Points**

Sample No. 185    Ave 88    S.D. 3.5    C.V. 4.0

Sample No. 186    Ave 88    S.D. 3.3    C.V. 3.7

Labs Eliminated: 40, 86, 125, 152, 243

**CCRL Proficiency Sample Program  
Compressive Strength - 3 day  
PORTLAND CEMENT Samples No. 185 and No. 186**



**Test No. 200    Compressive Strength - 3 day    242 Points**

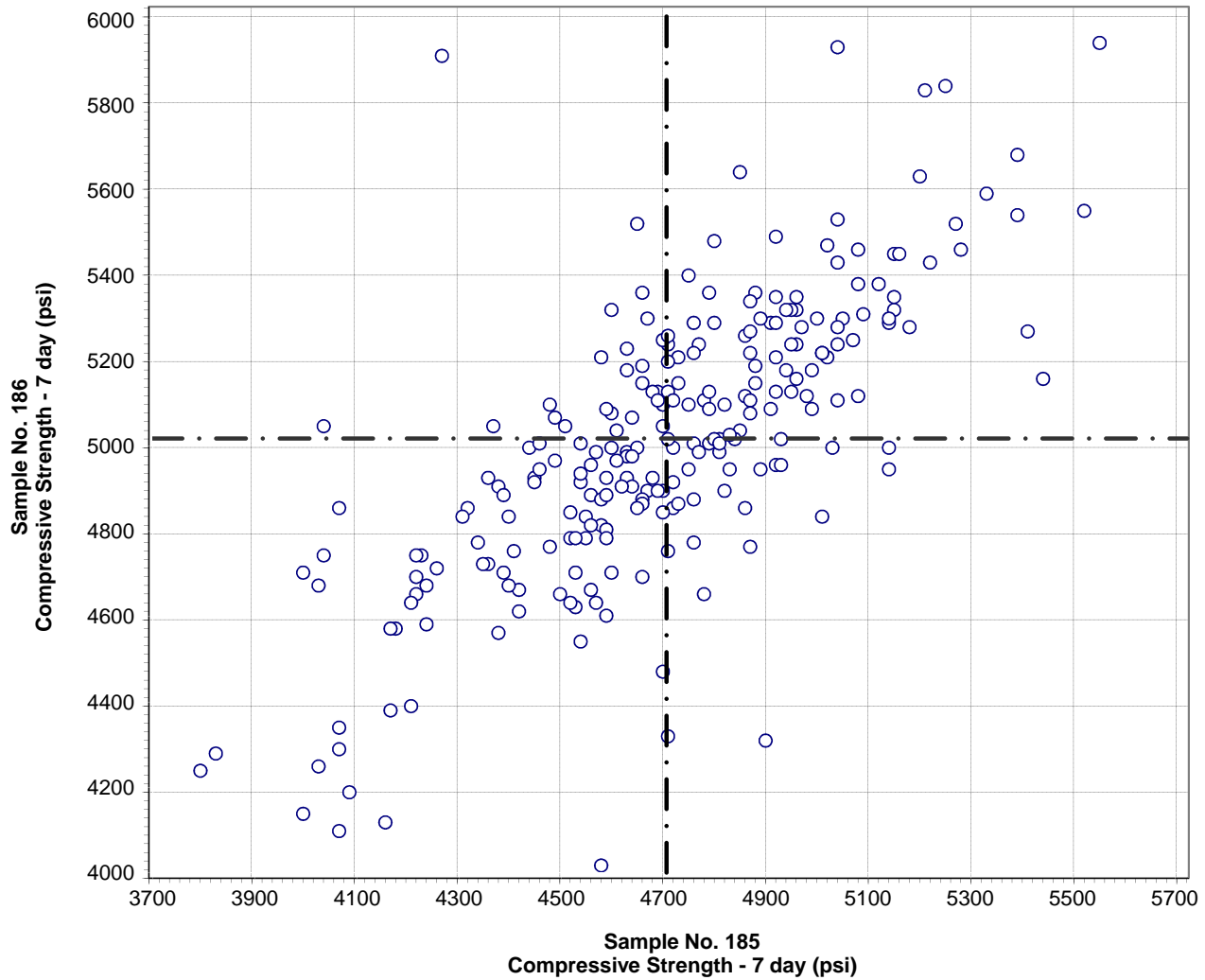
Sample No. 185    Ave 3629    S.D. 258    C.V. 7.1

Sample No. 186    Ave 3831    S.D. 270    C.V. 7.0

Labs Eliminated: 48, 51, 1435, 1525, 1526

Labs off Diagram: 691

**CCRL Proficiency Sample Program  
Compressive Strength - 7 day  
PORTLAND CEMENT Samples No. 185 and No. 186**



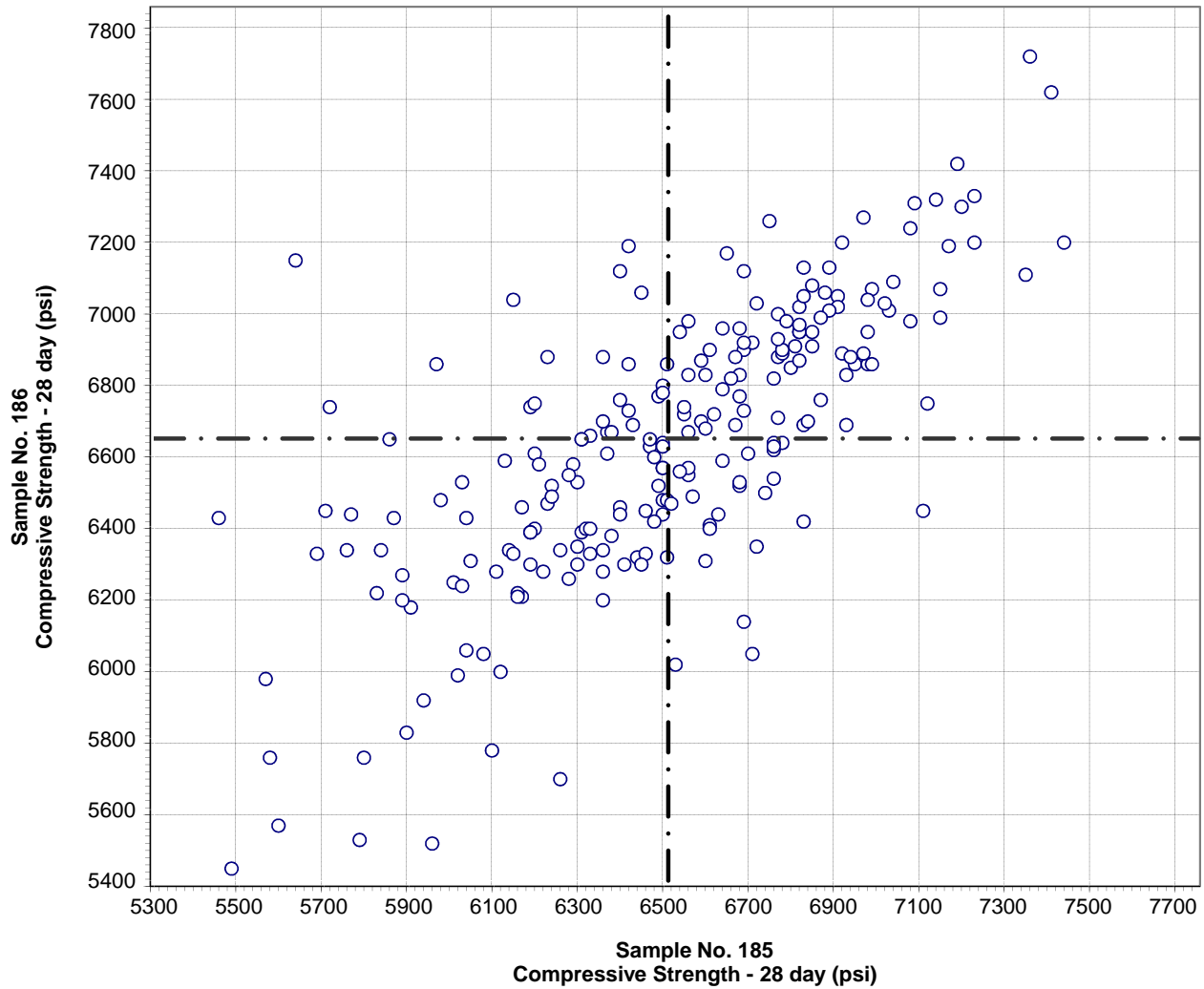
**Test No. 210    Compressive Strength - 7 day    242 Points**

Sample No. 185    Ave 4706    S.D. 318    C.V. 6.8

Sample No. 186    Ave 5018    S.D. 332    C.V. 6.6

Labs Eliminated: 26, 48, 51, 205, 694

**CCRL Proficiency Sample Program  
Compressive Strength - 28 day  
PORTLAND CEMENT Samples No. 185 and No. 186**



**Test No. 211    Compressive Strength - 28 day    226 Points**

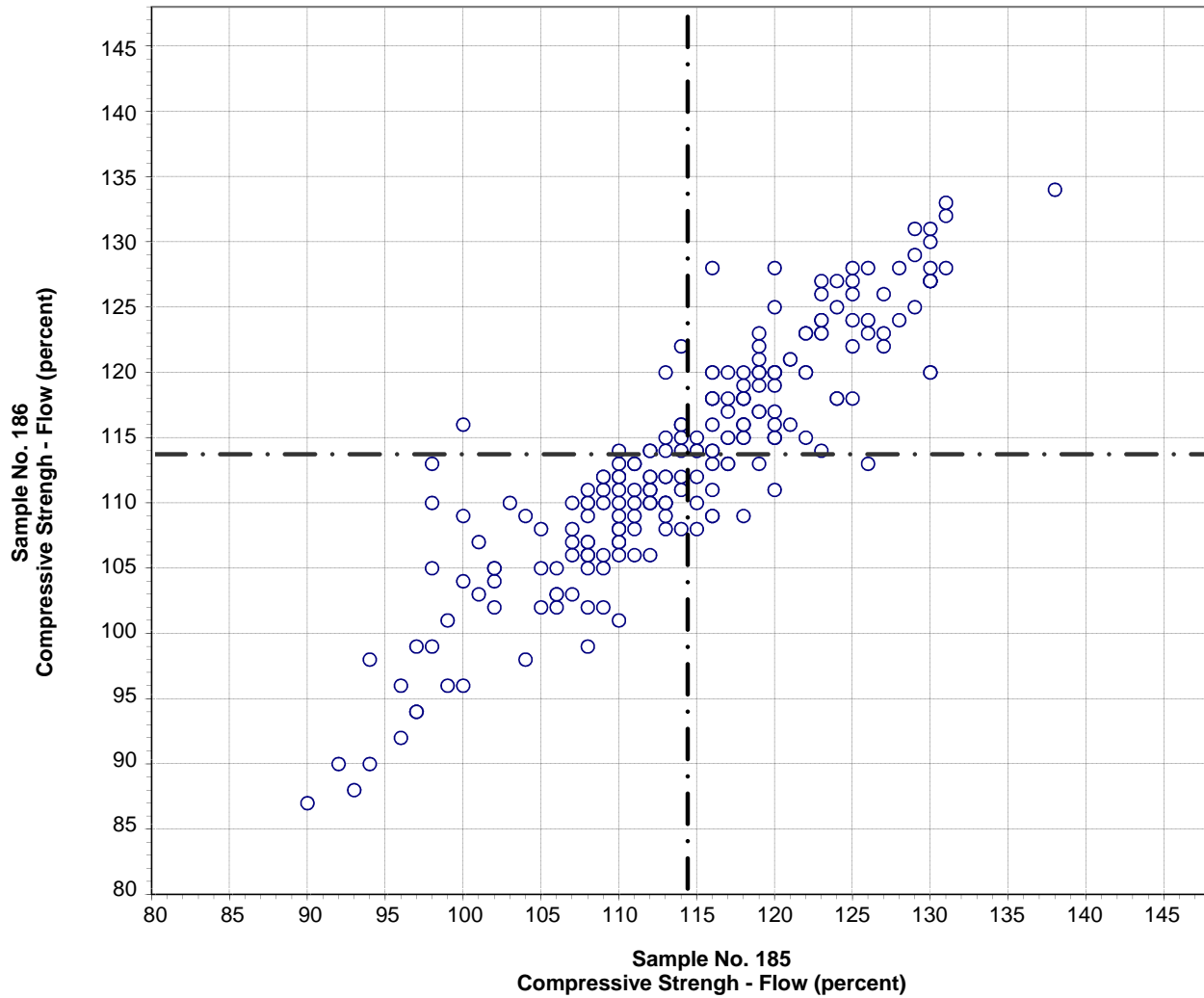
Sample No. 185    Ave 6511    S.D. 398    C.V. 6.1

Sample No. 186    Ave 6648    S.D. 392    C.V. 5.9

Labs Eliminated: 51, 694, 840, 2360

Labs off Diagram: 691

CCRL Proficiency Sample Program  
Compressive Strength - Flow  
PORTLAND CEMENT Samples No. 185 and No. 186



Test No. 230    Compressive Strength - Flow    218 Points

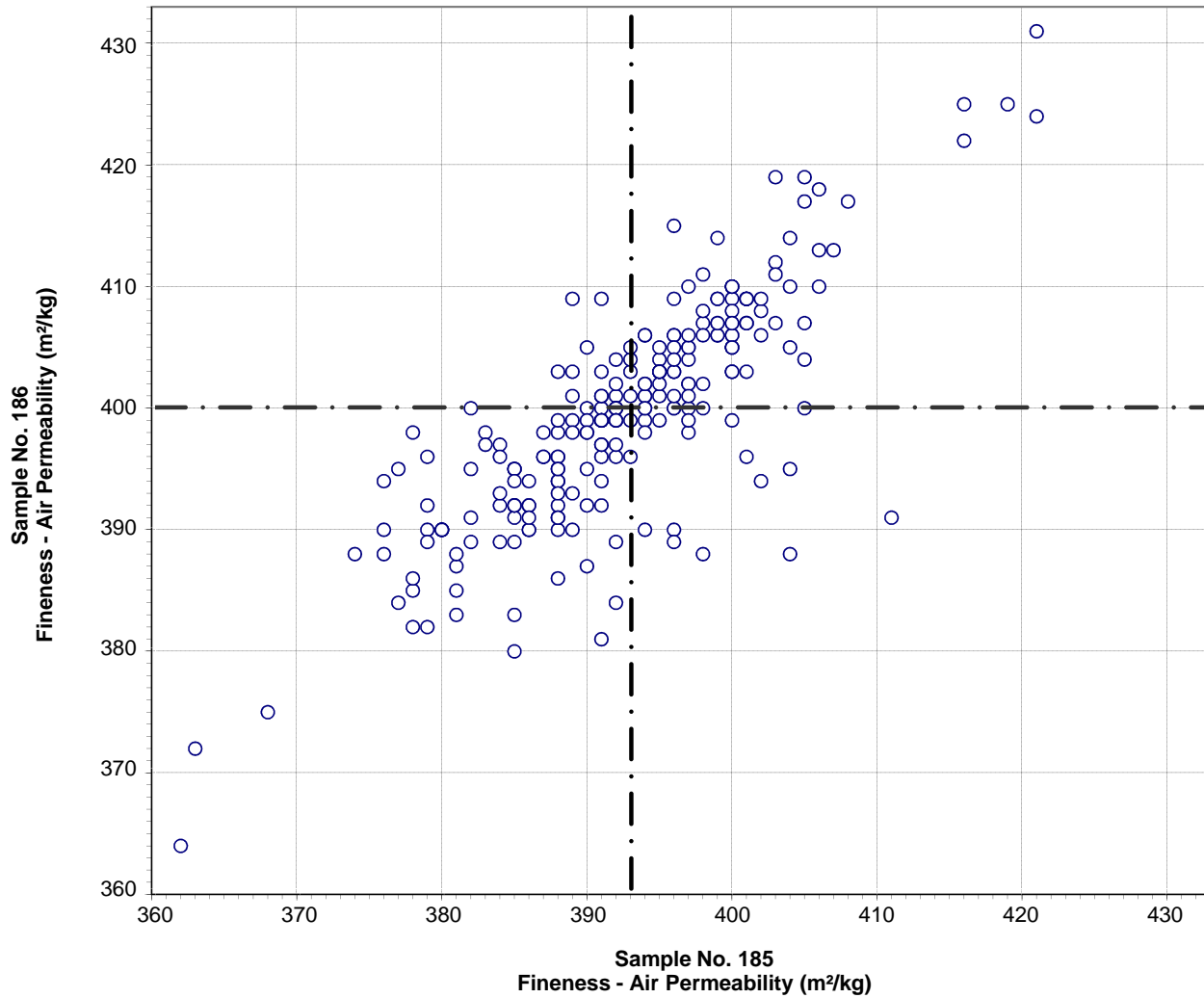
Sample No. 185    Ave 114    S.D. 9    C.V. 8.0

Sample No. 186    Ave 114    S.D. 9    C.V. 8.0

Labs Eliminated: 9, 34, 47, 49, 129, 222, 360, 3695



**CCRL Proficiency Sample Program  
Fineness - Air Permeability  
PORTLAND CEMENT Samples No. 185 and No. 186**



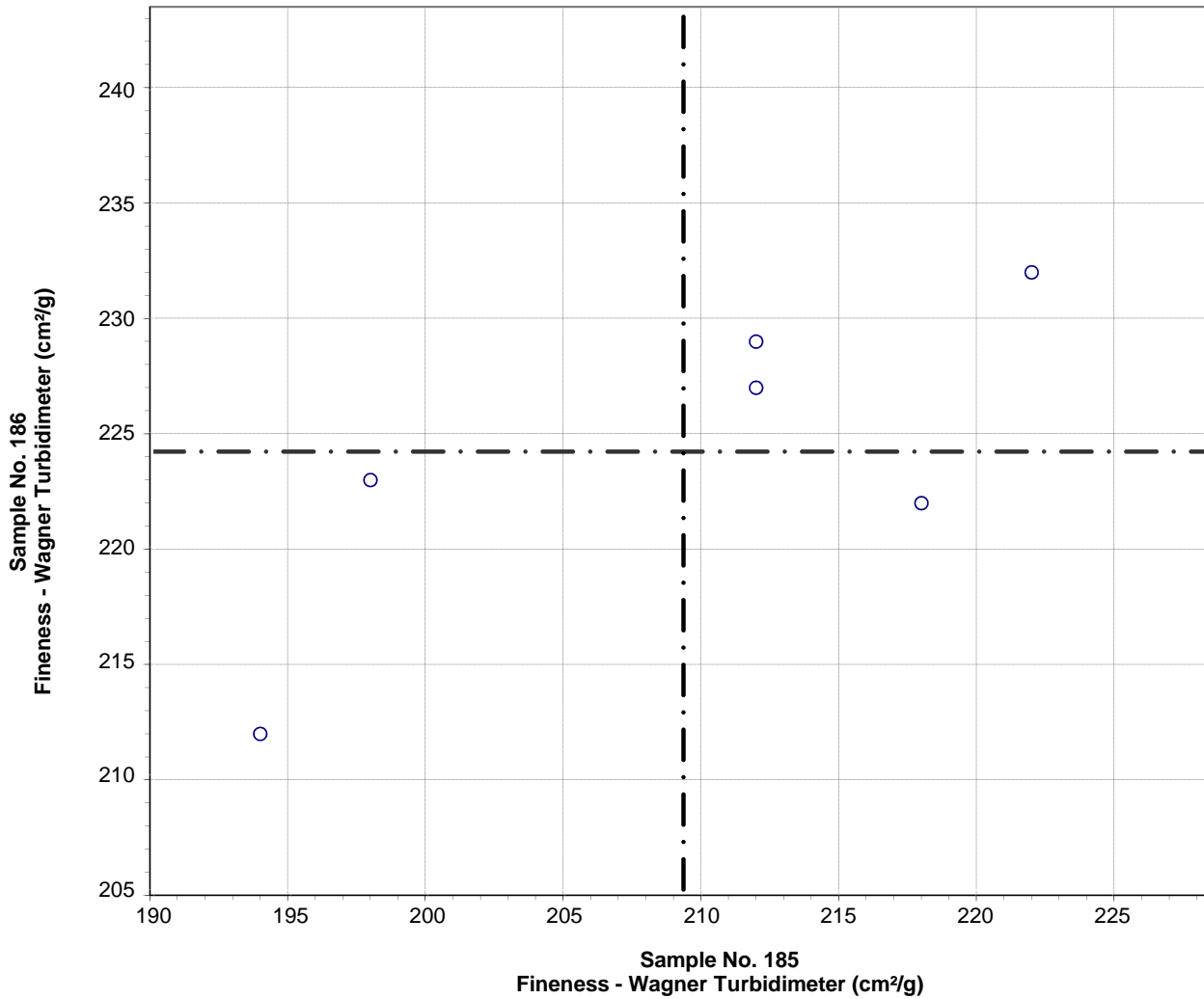
**Test No. 270    Fineness - Air Permeability    233 Points**

Sample No. 185    Ave 393    S.D. 9    C.V. 2.4  
Sample No. 186    Ave 400    S.D. 10    C.V. 2.5

Labs Eliminated: 40, 49, 103, 207, 958, 3511

Labs off Diagram: 46, 221, 1956

**CCRL Proficiency Sample Program  
 Fineness - Wagner Turbidimeter  
 PORTLAND CEMENT Samples No. 185 and No. 186**



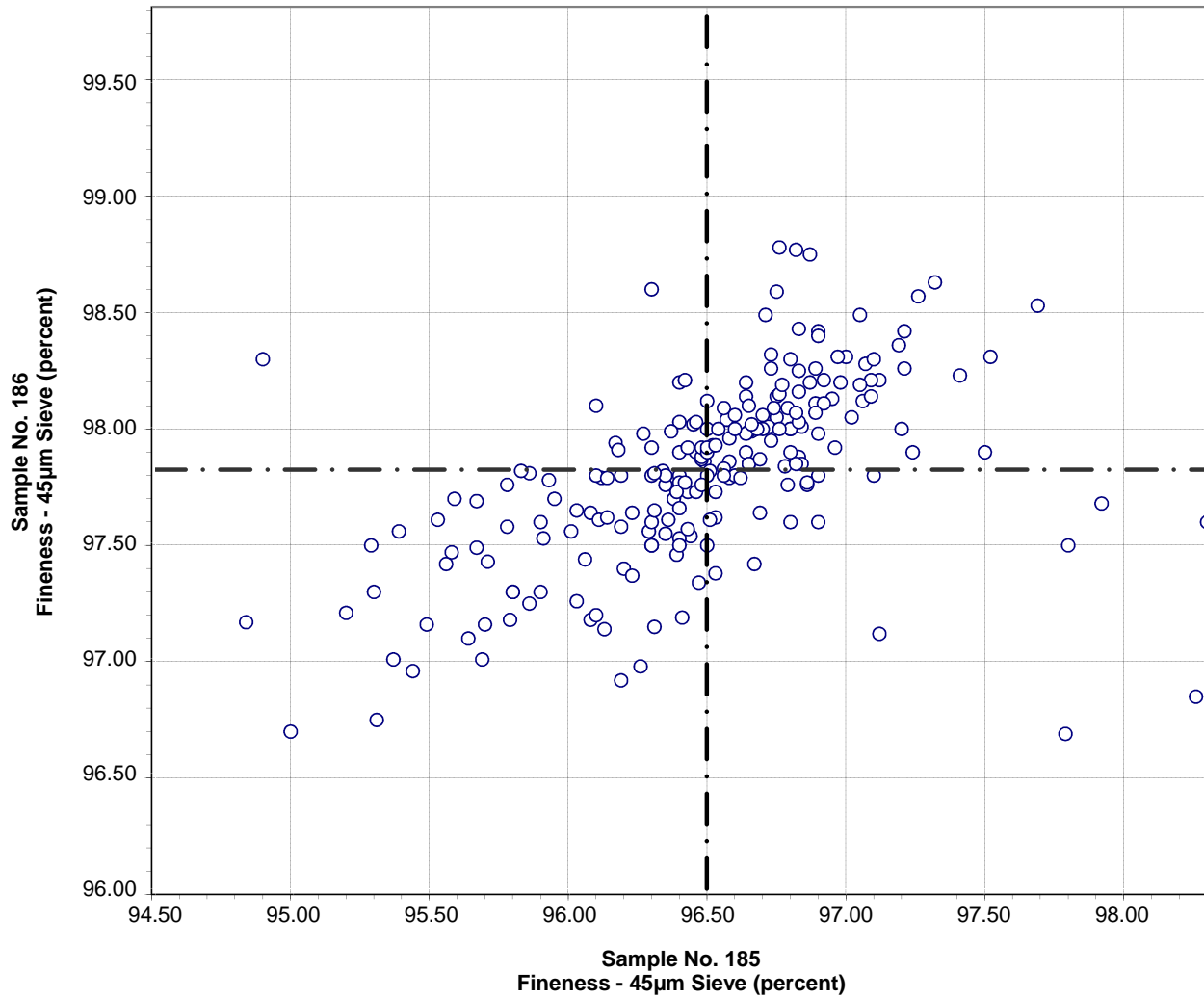
**Test No. 280    Fineness - Wagner Turbidimeter    6 Points**

Sample No. 185    Ave 209    S.D. 11    C.V. 5.3

Sample No. 186    Ave 224    S.D. 7    C.V. 3.1

Labs Eliminated: 1526

**CCRL Proficiency Sample Program**  
**Fineness - 45 $\mu$ m Sieve**  
**PORTLAND CEMENT Samples No. 185 and No. 186**



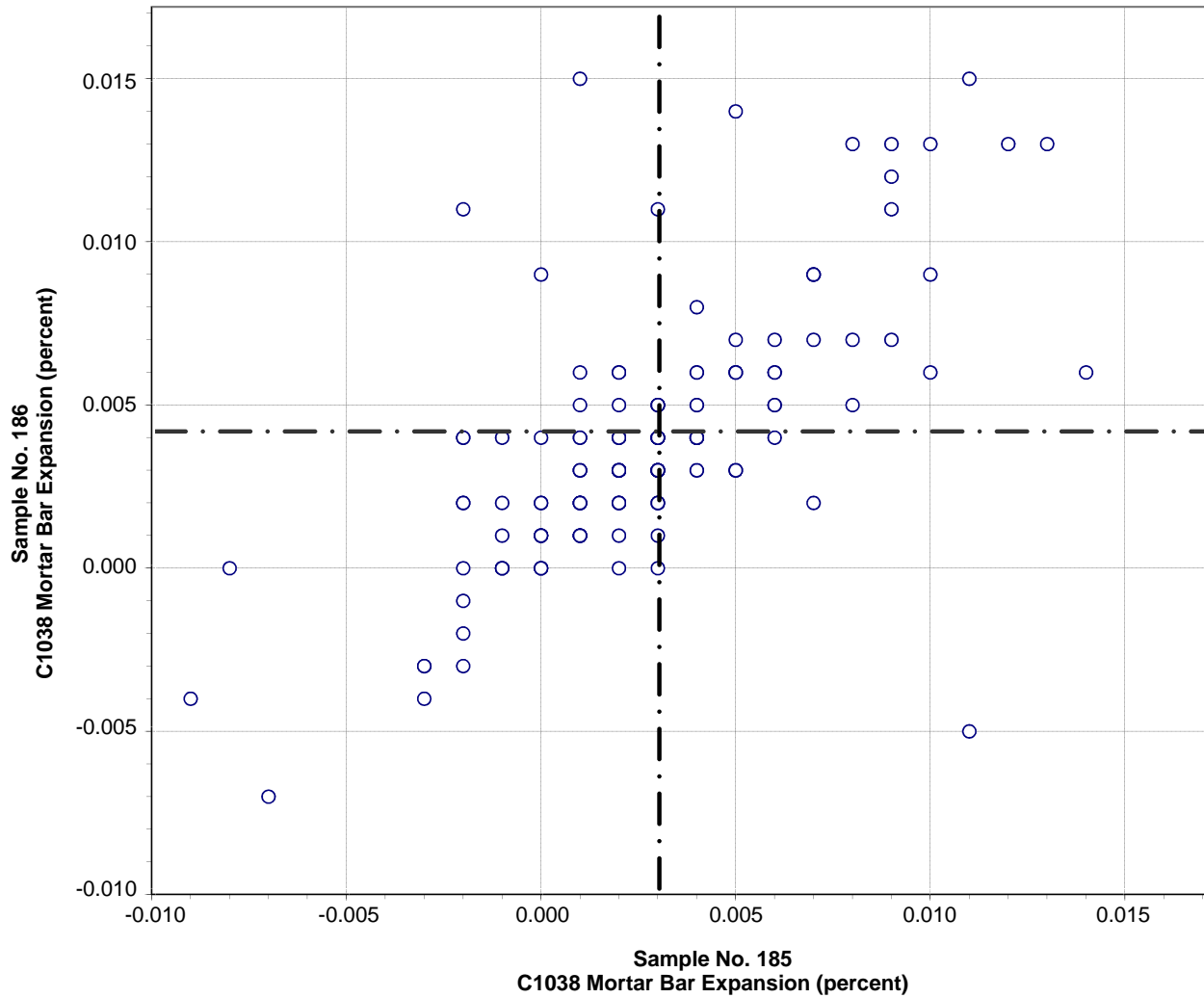
Test No. 281    Fineness - 45 $\mu$ m Sieve    220 Points

Sample No. 185    Ave 96.50    S.D. 0.54    C.V. 0.6

Sample No. 186    Ave 97.82    S.D. 0.40    C.V. 0.4

Labs Eliminated: 29, 40, 51, 70, 94, 95, 413, 415, 1435

**CCRL Proficiency Sample Program  
C1038 Mortar Bar Expansion  
PORTLAND CEMENT Samples No. 185 and No. 186**



**Test No. 400    C1038 Mortar Bar Expansion    137 Points**

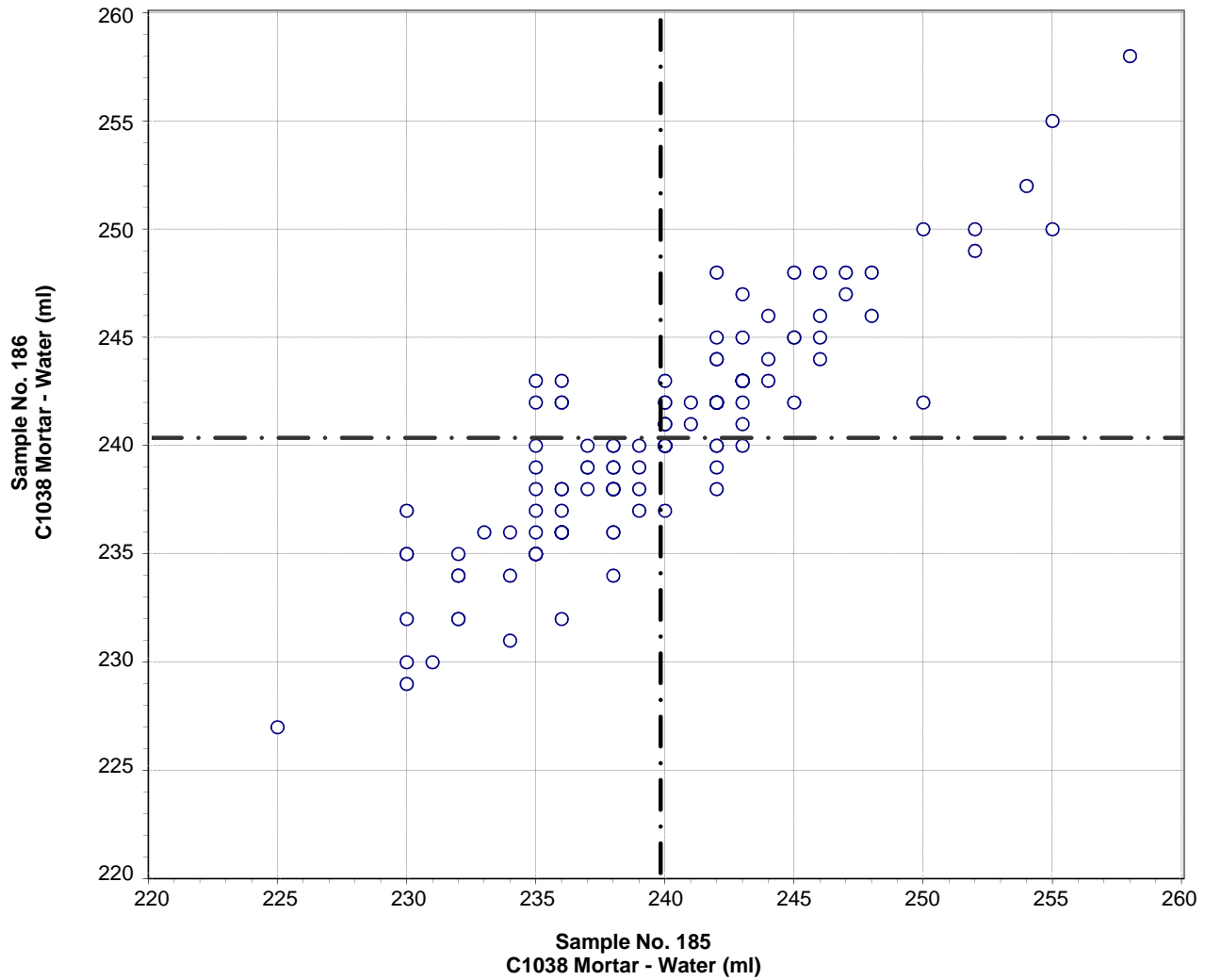
Sample No. 185    Ave 0.003    S.D. 0.004    C.V. 136

Sample No. 186    Ave 0.004    S.D. 0.004    C.V. 103

Labs Eliminated: 34, 51, 125, 497, 565, 1466, 3057, 3279, 3658

Labs off Diagram: 413, 691, 3059

**CCRL Proficiency Sample Program  
C1038 Mortar - Water  
PORTLAND CEMENT Samples No. 185 and No. 186**



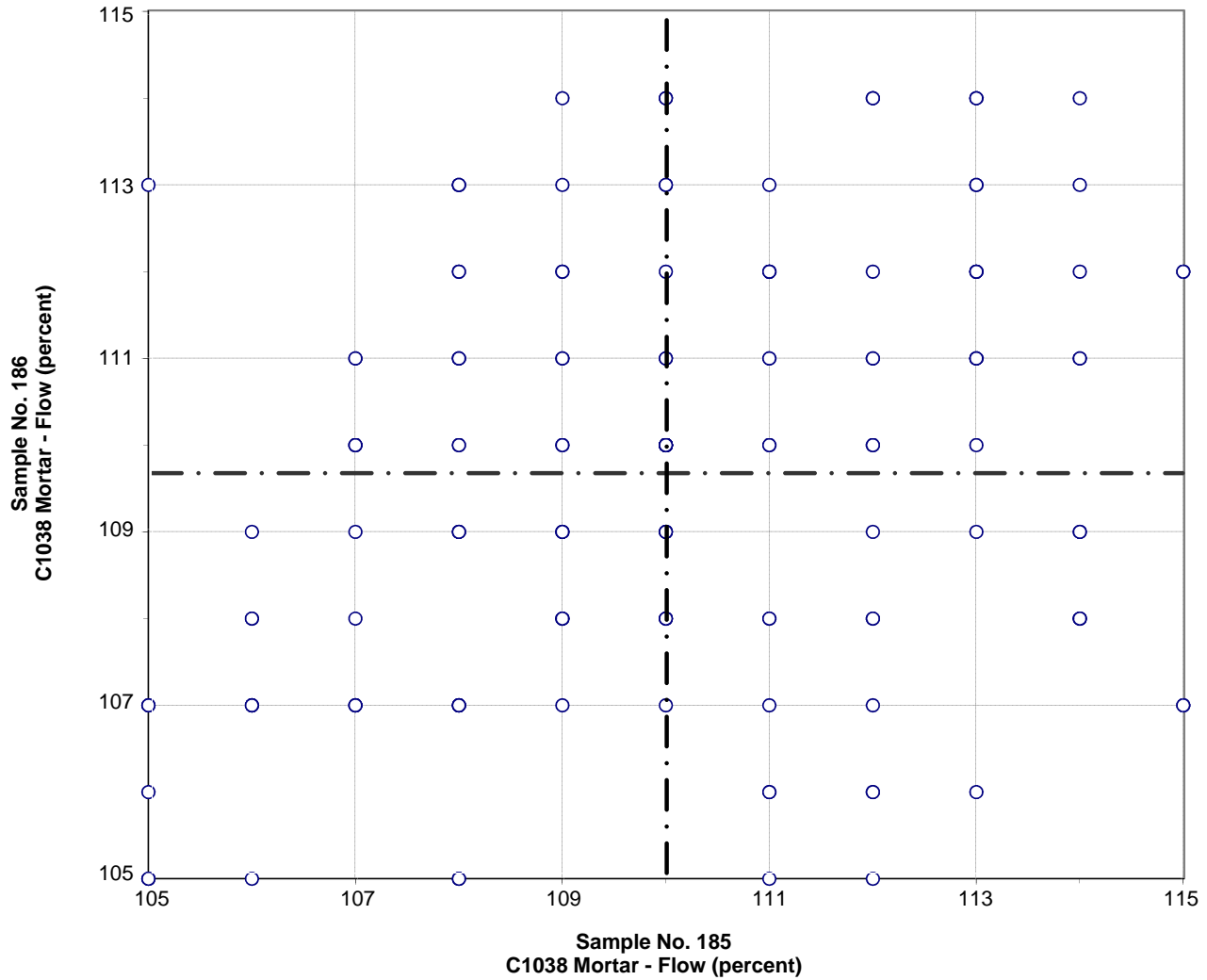
**Test No. 401    C1038 Mortar - Water    140 Points**

Sample No. 185    Ave 240    S.D. 5    C.V. 2.3

Sample No. 186    Ave 240    S.D. 5    C.V. 2.1

Labs Eliminated: 34, 123, 497, 565, 2462

**CCRL Proficiency Sample Program  
C1038 Mortar - Flow  
PORTLAND CEMENT Samples No. 185 and No. 186**



**Test No. 402    C1038 Mortar - Flow    137 Points**

Sample No. 185    Ave 110    S.D. 3    C.V. 2.3

Sample No. 186    Ave 110    S.D. 2    C.V. 2.2

Labs Eliminated: 46, 99, 491, 497, 2412, 3605, 3607

**CCRL PROFICIENCY SAMPLE PROGRAM**  
 Portland Cement Proficiency Samples No. 185 and No. 186

Final Report – Heat of Hydration Results  
 August 31, 2012

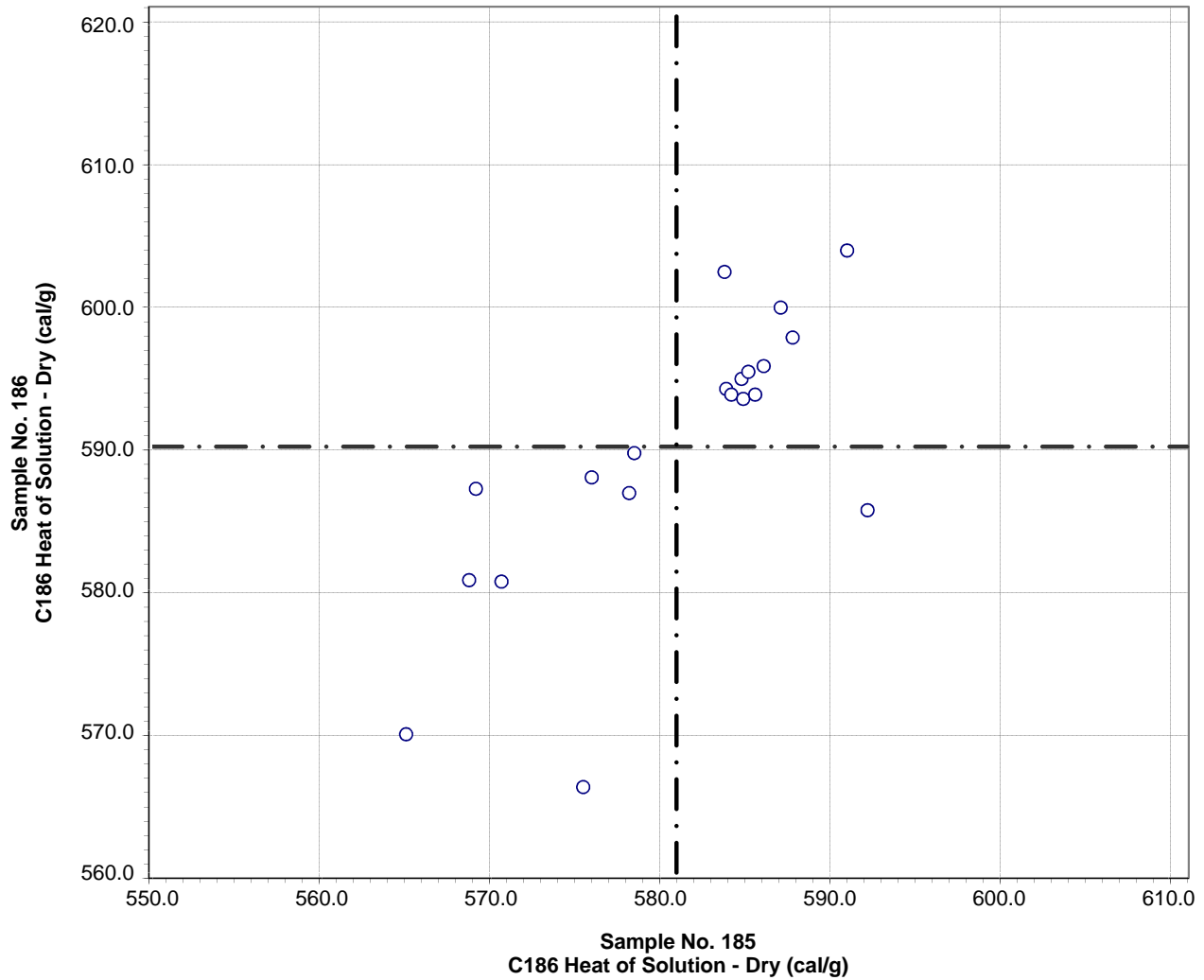
SUMMARY OF RESULTS

Sample No.185

Sample No. 186

Test (unit)	#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.
<b>C186 Heat of Solution - Dry (cal/g)</b>							
	24	570.0	53.0	9.3	575.0	57.2	9.9
	*20	581.0	7.8	1.3	590.0	9.8	1.7
* Labs Eliminated - 491, 1715, 3057, 3059							
<b>C186 Heat of Solution - 7 day (cal/g)</b>							
	23	506.4	25.8	5.1	516.4	24.8	4.8
	*20	503.0	7.5	1.5	511.7	7.3	1.4
* Labs Eliminated - 491, 1715, 3059							
<b>C186 Heat of Solution 28 day (cal/g)</b>							
	17	484.6	26.4	5.5	495.4	23.5	4.7
	*16	490.9	6.1	1.2	500.8	7.0	1.4
* Labs Eliminated - 126							
<b>C186 Heat of Hydration - 7 day (cal/g)</b>							
	25	77.4	6.9	8.9	78.7	15.0	19.1
	*23	78.0	6.8	8.7	79.0	6.0	7.6
* Labs Eliminated - 491, 3057							
<b>C186 Heat of Hydration - 28 day (cal/g)</b>							
	11	92.1	3.3	3.6	91.1	8.6	9.5
No Labs Eliminated for This Test							
<b>C1702 Heat of Hydration - 3 day (J/g)</b>							
	6	275	11	4.1	290	24	8.1
No Labs Eliminated for This Test							
<b>C1702 Heat of Hydration - 7 day (J/g)</b>							
	7	317	31	9.8	339	35	10.4
No Labs Eliminated for This Test							

**CCRL Proficiency Sample Program  
C186 Heat of Solution - Dry  
PORTLAND CEMENT Samples No. 185 and No. 186**



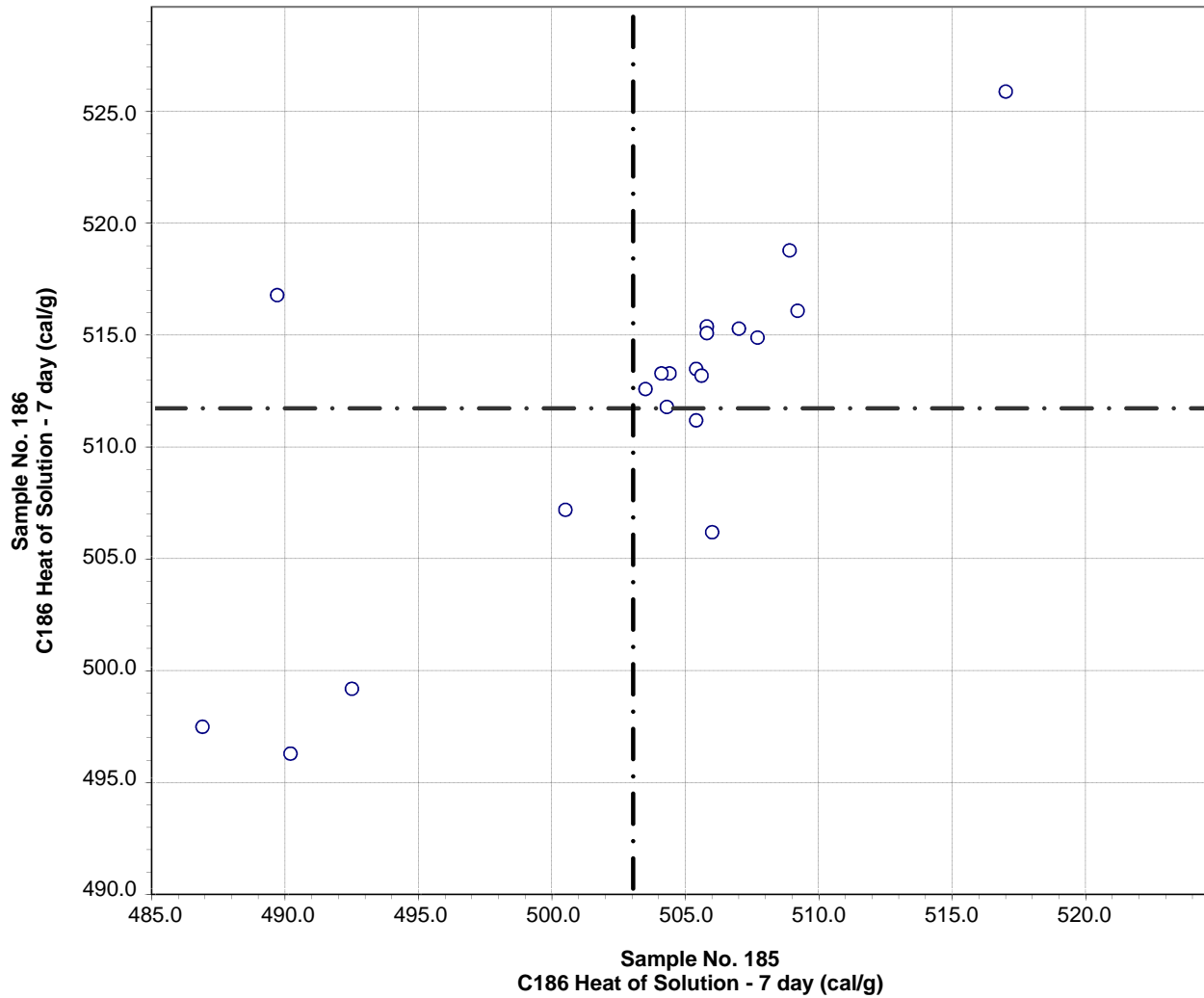
**Test No. 291    C186 Heat of Solution - Dry    20 Points**

Sample No. 185    Ave 581.0    S.D. 7.8    C.V. 1.3  
 Sample No. 186    Ave 590.0    S.D. 9.8    C.V. 1.7

Labs Eliminated: 491, 1715, 3057, 3059



**CCRL Proficiency Sample Program  
C186 Heat of Solution - 7 day  
PORTLAND CEMENT Samples No. 185 and No. 186**



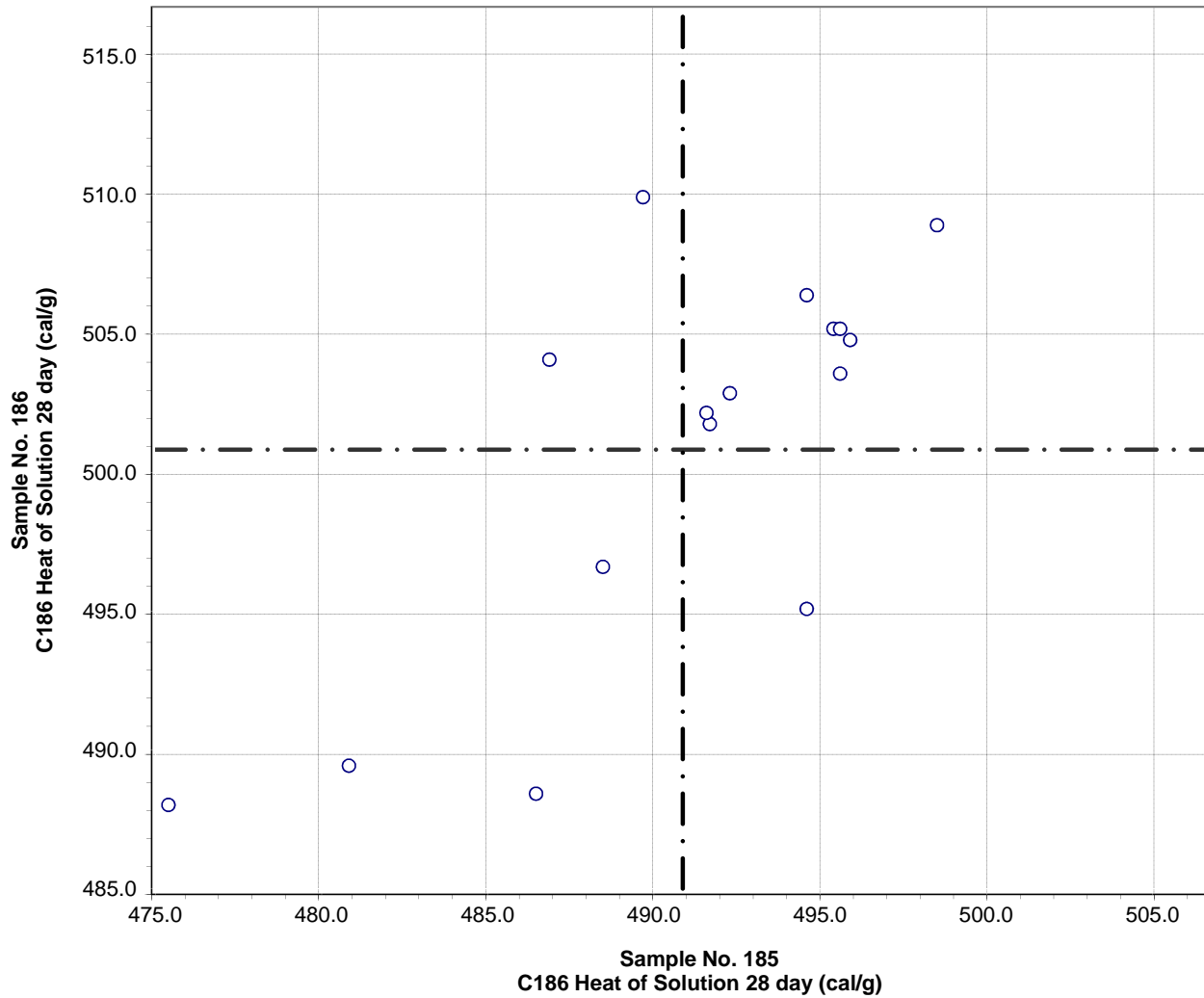
**Test No. 292    C186 Heat of Solution - 7 day    20 Points**

Sample No. 185    Ave 503.0    S.D. 7.5    C.V. 1.5

Sample No. 186    Ave 511.7    S.D. 7.3    C.V. 1.4

Labs Eliminated: 491, 1715, 3059

**CCRL Proficiency Sample Program  
C186 Heat of Solution 28 day  
PORTLAND CEMENT Samples No. 185 and No. 186**

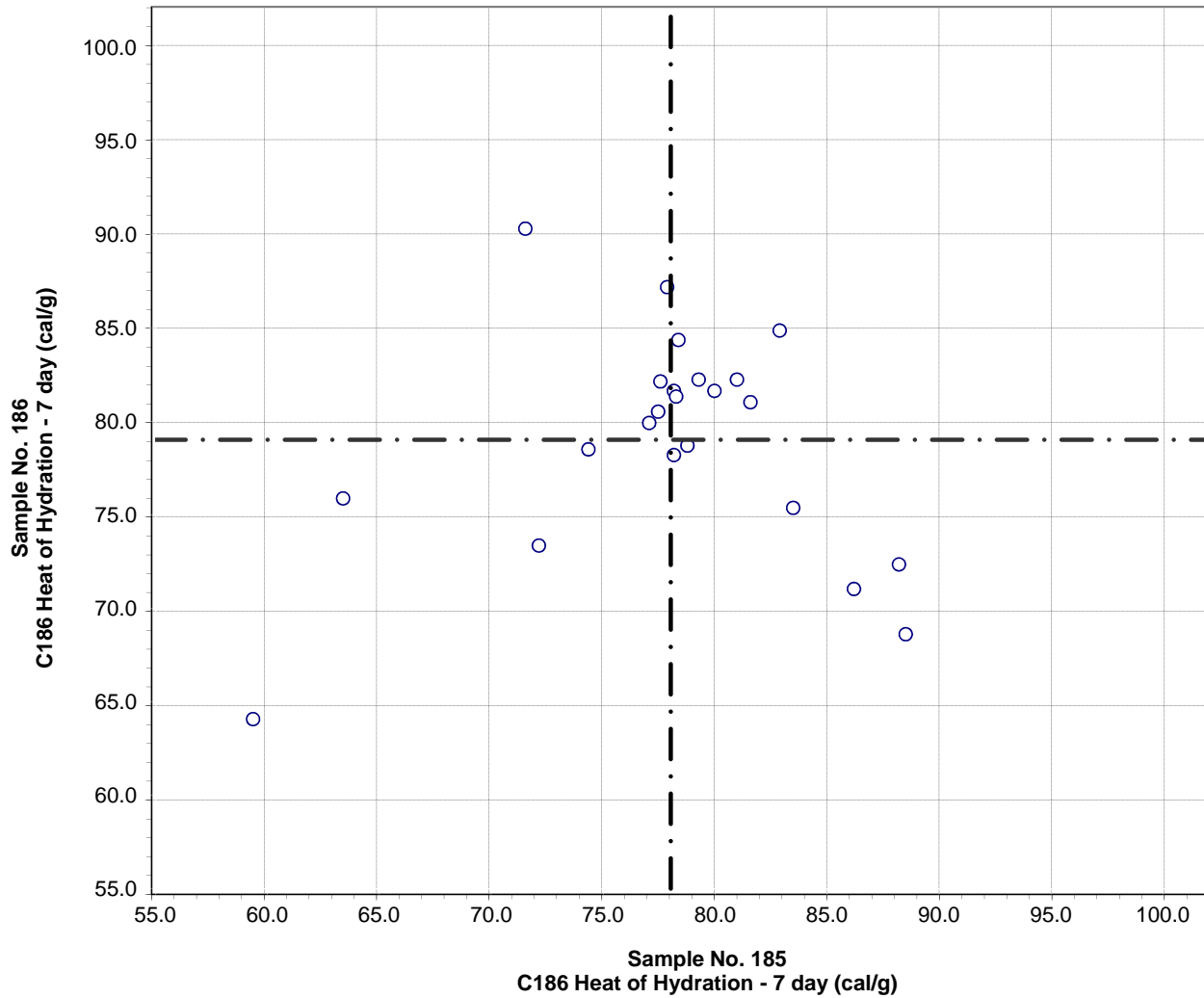


**Test No. 301    C186 Heat of Solution 28 day    16 Points**

Sample No. 185    Ave 490.9    S.D. 6.1    C.V. 1.2  
 Sample No. 186    Ave 500.8    S.D. 7.0    C.V. 1.4

Labs Eliminated: 126

**CCRL Proficiency Sample Program  
C186 Heat of Hydration - 7 day  
PORTLAND CEMENT Samples No. 185 and No. 186**



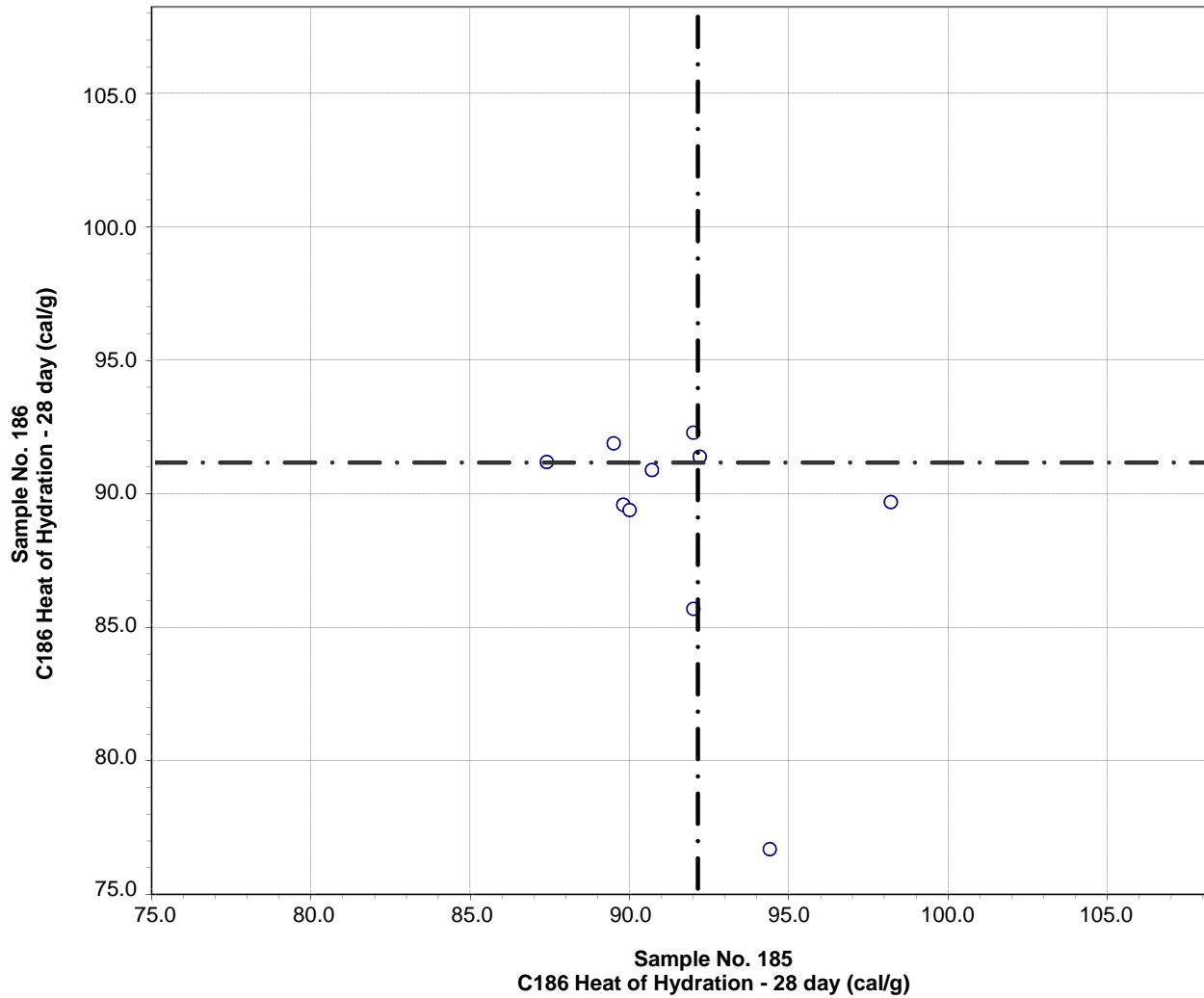
Test No. 290    C186 Heat of Hydration - 7 day    23 Points

Sample No. 185    Ave 78.0    S.D. 6.8    C.V. 8.7

Sample No. 186    Ave 79.0    S.D. 6.0    C.V. 7.6

Labs Eliminated: 491, 3057

**CCRL Proficiency Sample Program  
C186 Heat of Hydration - 28 day  
PORTLAND CEMENT Samples No. 185 and No. 186**

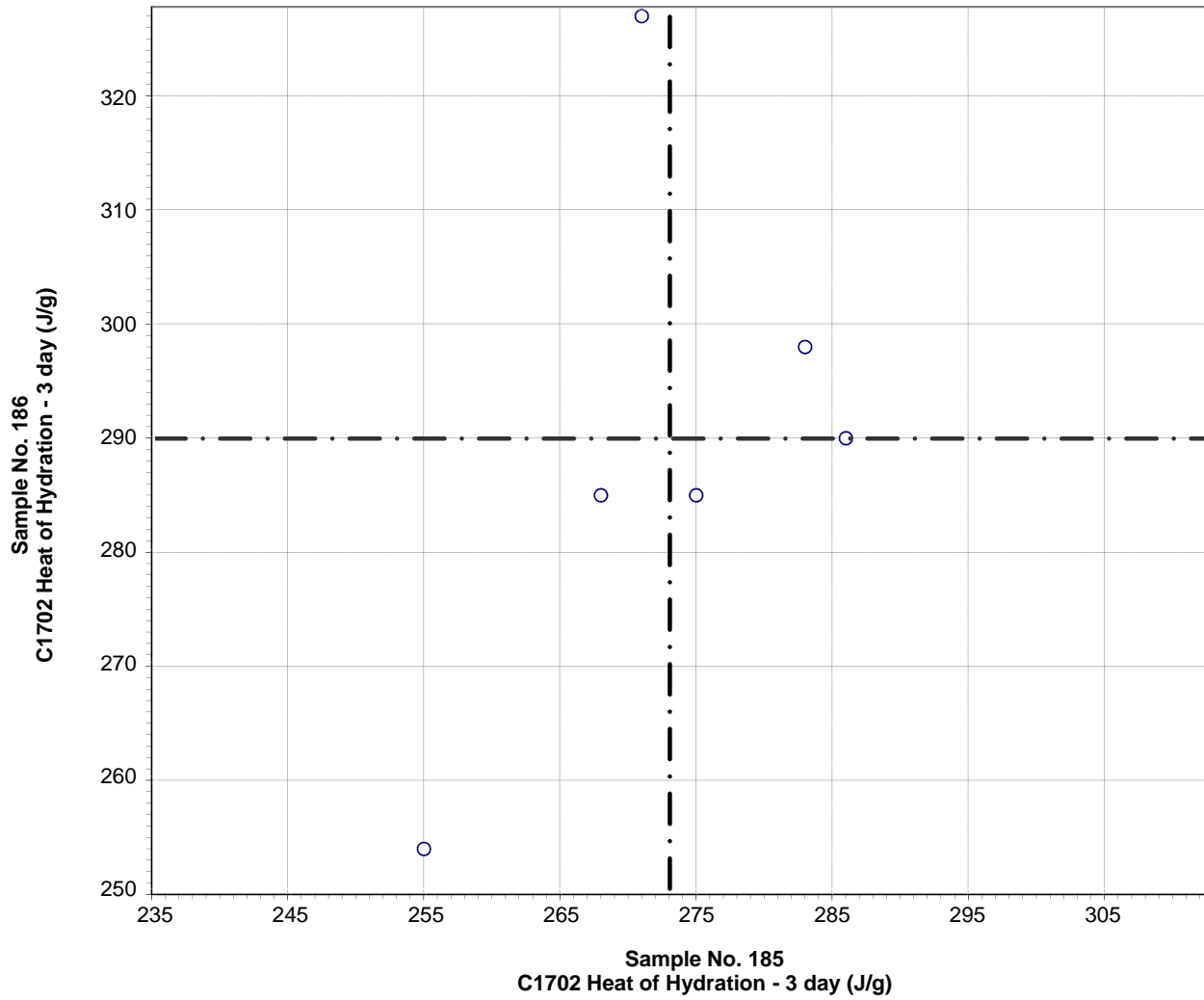


**Test No. 300    C186 Heat of Hydration - 28 day    10 Points**

Sample No. 185    Ave 92.1    S.D. 3.3    C.V. 3.6  
 Sample No. 186    Ave 91.1    S.D. 8.6    C.V. 9.5

Labs off Diagram: 3606

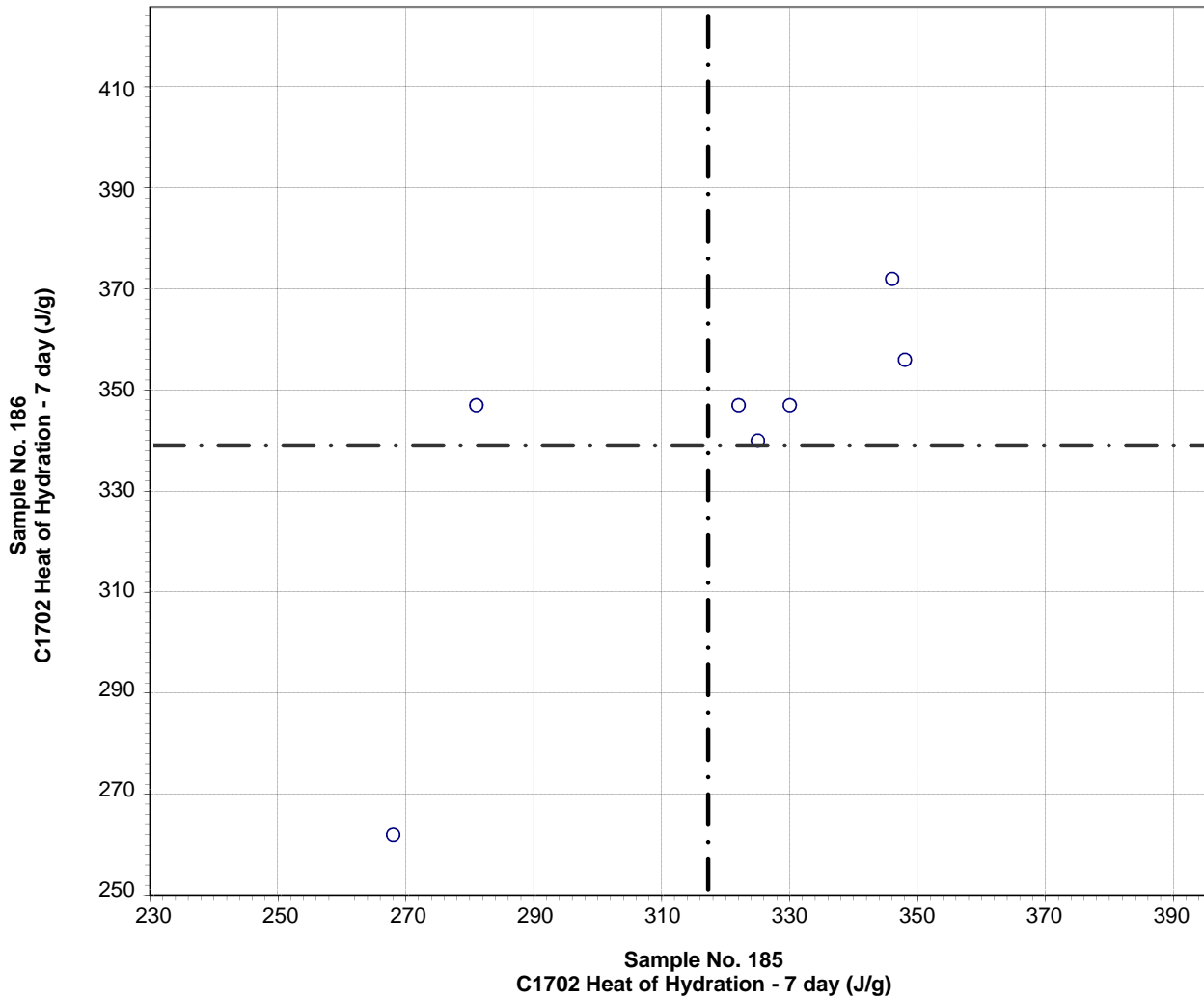
CCRL Proficiency Sample Program  
C1702 Heat of Hydration - 3 day  
PORTLAND CEMENT Samples No. 185 and No. 186



Test No. 500 C1702 Heat of Hydration - 3 day 6 Points

Sample No. 185 Ave 275 S.D. 11 C.V. 4.1  
Sample No. 186 Ave 290 S.D. 24 C.V. 8.1

CCRL Proficiency Sample Program  
C1702 Heat of Hydration - 7 day  
PORTLAND CEMENT Samples No. 185 and No. 186



Test No. 510 C1702 Heat of Hydration - 7 day 7 Points

Sample No. 185	Ave 317	S.D. 31	C.V. 9.8
Sample No. 186	Ave 339	S.D. 35	C.V. 10.4